MILITARY STANDARD

STANDARD GENERAL REQUIREMENTS FOR ELECTRONIC EQUIPMENT

TO ALL HOLDERS OF MIL-STD-454L:

1. THE FOLLOWING PAGES OF MIL-STD-454L HAVE BEEN REVISED AND SUPERSEDE THE PAGES LISTED:

NEW PAGES	DATE	SUPERSEDED PAGES	DATE
1-1 thru 1-10	30 Jun 89	1-1 thru 1-10	16 Feb 89
4-1 thru 4-3	30 Jun 89	4-1 thru 4-3	16 Feb 89
6-1 thru 6-2	30 Jun 89	6-1 thru 6-2	10 Sep 87
10-1 thru 10-4	30 Jun 89	10-1 thru 10-4	20 Sep 88
11-1 thru 11-2	30 Jun 89	11-1 thru 11-2	16 Feb 89
17-1 thru 17-2	30 Jun 89	17-1 thru 17-2	12 Feb 88
19-1 thru 19-2	30 Jun 89	19-1 thru 19-2	20 Sep 88
20-1 thru 20-5	30 Jun 89	20-1 thru 20-5	16 Feb 89
23-1 thru 23-2	30 Jun 89	23-1 thru 23-2	16 Feb 89
26-1 thru 26-2	30 Jun 89	26-1 thru 26-2	16 Feb 89
30-1	30 Jun 89	30-1	20 Sep 88
41-1 thru 41-4	30 Jun 89	41-1 thru 41-4	10 Sep 87
42-1	30 Jun 89	42-1	10 Sep 87
43-1 thru 43-2	30 Jun 89	43-1 thru 43-2	10 Sep 87
44-1 thru 44-2	30 Jun 89	44-1 thru 44-2	10 Sep 87
46-1 thru 46-2	30 Jun 89	46-1 thru 46-2	20 Sep 88
47-1 thru 47-2	30 Jun 89	47-1 thru 47-2	16 Feb 89
50-1 thru 50-2	30 Jun 89	50-1 thru 50-2	20 Sep 88
52-1 thru 52-3	30 Jun 89	52-1 thru 52-3	12 Feb 88
66-1 thru 66-5	30 Jun 89	66-1 thru 66-5	12 Feb 88
71-1 thru 71-8	30 Jun 89	71-1 thru 71-8	12 Feb 88
I1-1 thru I1-8	30 Jun 89	I1-1 thru I1-8	16 Feb 89

2. MAKE THE FOLLOWING PEN AND INK CHANGE:

Page 1, paragraph 1.2.1, line 2 - Delete "one" and substitute "once".

AMSC N/A FSC-GDRQ

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3. RETAIN THIS NOTICE AND INSERT BEFORE TABLE OF CONTENTS.

4. Holders of MIL-STD-454L will verify that page changes and additions indicated above have been entered. This notice page will be retained as a check sheet. This issuance, together with appended pages, is a separate publication. Each notice is to be retained by stocking points until the Military Standard is completely revised or cancelled.

Custodians:
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Navy - AS
Air Force - 11

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Navy - EC, OS, SH
Air Force - 17, 19, 85
DLA - ES, IS
FAA

Preparing activity:
Air Force - 10

Agent:
Air Force - 11

Project GDRQ-0079

REQUIREMENT 1

SAFETY DESIGN CRITERIA - PERSONNEL HAZARDS

1. Purpose. This requirement establishes safety design criteria and provides guidelines for personnel protection.

* 2. Documents applicable to Requirement 1:

MIL-B-5087	Bonding, Electrical, and Lightning Protection, for Aerospace Systems
MIL-STD-1310	Shipboard Bonding, Grounding, and Other Techniques for Electromagnetic Compatibility and Safety Shielding
MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment and Facilities
MIL-HDBK-600	Guidelines for Identification, Markings, Labeling, Storage, and Transportation of Radioactive Commodities
ANSI C95.1-1982	Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 300 KHz to 100 GHz
ANSI C95.2-1982	Radio Frequency Radiation Hazard Warning Symbol
ANSI N2.1-1969	Radiation Symbol
ANSI Z35.1-1972	Accident Prevention Signs, Specification for
ANSI Z35.2-1968	Accident Prevention Tags, Specification for
ANSI Z35.4-1973	Specification for Informational Signs Complementary to ANSI Z35.1, Accident Prevention Signs
ANSI Z53.1-1979	Marking Physical Hazards, Safety Color Code for
NFPA 70-1987	National Electrical Code
10 CFR 20	
21 CFR 1000-1050	
29 CFR 1910	

3. Definitions

3.1 Chassis, electrical equipment. The chassis is a structural item fabricated in such manner as to facilitate assemblage and interconnection of electrical or electronic items for the specific purpose of providing a basis for electrical or electronic circuits. It normally has drilled or stamped holes to accommodate the items but may include only the items necessary for its own mounting and support.

3.2 Frame. The frame is any construction system fitted and united together, designed for mounting or supporting electrical or electronic parts or units.

3.3 Fail-safe. The design feature of a part, unit or equipment which allows the item to fail only into a non-hazardous mode.

3.4 Interlock. An interlock is an automatic switch which eliminates all power from the equipment when an access door, cover or plate is removed.

3.4.1 Bypassable interlock. A bypassable interlock is an automatic switch with a manually operated electrical bypass device to allow equipment maintenance operations on energized equipment.

3.5 Battleshort. A switch used to bypass normal interlocks in mission critical equipment (i.e., equipment which must not be shut down or the mission function will fail) during battle conditions.

4. Requirements

4.1 Fail-safe. The design and development of all military electronic equipment shall provide fail-safe features for safety of personnel during the installation, operation, maintenance, and repair or interchanging of a complete equipment assembly or component parts thereof.

4.2 Bonding in hazardous areas. Electronic equipment to be installed in areas where explosive or fire hazards exist shall be bonded in accordance with MIL-B-5087 for aerospace systems, MIL-STD-1310 for shipboard systems, and NFPA 70, Chapter 5, for ground systems, or as otherwise specified in the detail equipment specification.

4.3 Temperature. At an ambient temperature of 25°C, the operating temperature of control panels and operating controls shall not exceed 49°C. Other exposed parts subject to contact by operating personnel shall not exceed 60°C.

4.4 Electrical. The design shall incorporate methods to protect personnel from inadvertent contact with voltages capable of producing shock hazards.

4.4.1 Power. Means shall be provided so that power may be cut off while installing, replacing, or interchanging a complete equipment, assembly, or part thereof. Interface with electrical power sources shall be in accordance with the applicable regulations or requirements. If a main power switch is provided, it shall be clearly labeled as such and shall cut off all power to the complete equipment.

4.4.2 Ground. The design and construction of equipment, excluding self-powered equipment, shall insure that all external parts, surfaces, and shields, exclusive of antenna and transmission line terminals, are at ground potential at all times during normal operation. The design shall include consideration of ground currents and voltage limits (possible arcing) established on a basis of hazardous location. Antenna and transmission line terminals shall be at ground potential, except for radio frequency (rf) energy on their external surfaces.

4.4.2.1 Self-powered equipment. Self-powered equipment shall have all external surfaces at the same potential.

4.4.2.2 Grounding methods. Plugs for use with metal cased portable tools and equipment shall have provisions for automatically grounding the metal frame or case of tools and equipment when the plug is mated with receptacle, and the grounding pin shall make first, break last. Ground connections to shields, hinges, and other mechanical parts shall not be used to complete electrical circuits. Any external or interconnecting cable, where a ground is part of the circuit, shall carry a ground wire in the cable terminated at both ends in the same manner as the other conductors. In no case, except with coaxial cables, shall the shield be depended upon for a current-carrying ground connection. Static and safety grounds shall not be used to complete electrical circuits. A point on the electrically conductive chassis or equipment frame shall serve as the common tie point for static and safety grounding. The path from the tie point to ground shall:

a. Be continuous and permanent,

b. Have ample carrying capacity to conduct safely any fault currents that may be imposed upon it,

c. Have impedance sufficiently low to limit the potential above ground and to facilitate the operation of the over current devices in the circuits, and

d. Have sufficient mechanical strength of the material to minimize possibility of ground disconnection.

4.4.2.3 Hinged or slide-mounted panels and doors. Hinges or slides shall not be used for grounding paths. Panels and doors containing meters, switches, test points, etc, shall be attached or hinged in such a manner as to insure that they are at the same ground potential as the equipment in which they are mounted, whether in a closed or open position. A ground shall be considered satisfactory if the electrical connection between the door or panel and the system tie point exhibits a resistance of 0.1 ohm or less and has sufficient ampacity to insure the reliable and immediate tripping of equipment over-current protection devices.

4.4.2.4 Shielding. Except where a conflict with single-point shield grounding requirements would be created, shielding on wire or cable shall be grounded to the chassis or frame. The shielding shall be secured to prevent it from contacting exposed current-carrying parts or grounding to the chassis or frame at any point other than the ground termination. The shielding shall end at a sufficient distance from exposed conductors to prevent shorting or arcing between the conductor and the shielding.

4.4.3 Accidental contact. The design shall incorporate methods to protect personnel from accidental contact with voltages in excess of 30 volts rms or dc during normal operation of a complete equipment.

4.4.3.1 Guards and barriers. All contacts, terminals and like devices having voltages between 70 and 500 volts rms or dc with respect to ground shall be guarded from accidental contact by personnel if such points are exposed to contact during direct support or operator maintenance. Guards or barriers may be provided with test probe holes where maintenance testing is required.

4.4.3.2 High voltage guarding. Assemblies operating at potentials in excess of 500 volts shall be completely enclosed from the remainder of the assembly and equipped with nonbypassable interlocks.

4.4.3.3 Voltage measurement. When the operation or maintenance of equipment employing potentials in excess of 300 volts peak could require that these voltages be measured, the equipment shall be provided with test points so that these voltages can be measured at a relatively low potential level. In no case shall the potential exceed 300 volts peak relative to ground. Test points with voltages above 30 volts shall have the conducting material recessed a distance no less than the diameter of the the probe hole and a minimum of 1.5 mm. If a voltage divider is used, the voltage divider resistance between the test point and ground shall consist of at least two resistors of equal value in parallel.

4.4.3.4 Guarding of rf voltages. Transmitter output terminals, antennas and other devices that carry sufficient rf voltage to burn or injure personnel shall be protected from accidental contact in the same manner as for ac voltages in the 70 to 500 volt range.

4.4.3.5 Main power switch. The power input side of the main power switch and the incoming power line connections shall be given physical protection against accidental contact.

4.4.4 Protective devices

4.4.4.1 Interlocks. When a unit is provided with access doors, covers or plates, these access points shall be interlocked as follows:

a. No interlocks are required when all potentials in excess of 70 volts are completely protected with guards or barriers to prevent accidental contact under all conditions of operation or any level of maintenance.

b. Bypassable interlocks are required when voltages between 70 and 500 volts are exposed as the result of an access door, cover, or plate being opened. Note that these internal voltages are allowed to be unguarded only if they are not exposed during direct support or operator maintenance. The bypass device shall be of such design that closing the associated door, cover or plate will automatically open the bypass device and leave the interlock in position to function normally. Visual means shall be provided to indicate when the interlock is bypassed.

c. Nonbypassable interlocks are required when any voltage in excess of 500 volts is exposed as a result of an access door, cover or plate being opened.

4.4.4.2 Battle short indicator. When a battle short switch is required by the individual equipment specification, a readily visible indicator light shall be provided to indicate when the battle short switch is ON.

4.4.4.3 Safety switches. Safety switches which will deactivate associated mechanical drive units shall be provided for the purpose of disconnecting these units without disconnecting other parts of the equipment. Such remotely located units and assemblies shall have provision for nonoverrideable safety switches to allow independent disconnection in the associated equipment.

4.4.5 Discharging devices

4.4.5.1 Automatic discharge devices. High voltage circuits and capacitors shall be provided with discharging devices unless they discharge to 30 volts or less within two seconds after power removal. The particular discharging device that is chosen shall insure that the capacitor or high voltage circuit is discharged to 30 volts or less within two seconds. These protective devices shall be positive acting, highly reliable, and shall actuate automatically either by mechanical release or by electrical solenoid when the door or cover is opened. When resistive bleeder networks are used to discharge capacitors, the bleeder network shall consist of at least two equal valued resistors in parallel.

4.4.5.2 Shorting rods. Shorting rods shall be provided with all transmitting equipment where voltages are in excess of 70 volts rms or dc. Where size permits, shorting rods shall be stored within the transmitting equipment, permanently attached, and readily accessible to maintenance personnel. The permanently attached rod shall be connected through a flexible stranded copper wire (covered with a transparent sleeving) to the stud provided at the transmitter main frame. Where size does not permit internal storage of the shorting rod, a grounding stud shall be provided to permit attachment of a portable shorting rod. The connection to the stud shall be such that accidental loosening or high resistance to the ground is prevented.

4.4.6 Connectors. Connectors used in multiple electric circuits shall be selected to preclude mismating. Where design considerations require plug and receptacles of similar

configuration in close proximity, the mating plugs and receptacles shall be suitably coded or marked to clearly indicate the mating connectors. Plugs and receptacles shall not be of similar configuration if the major unit contains explosive items. The design of the connector shall be such that the operator is not exposed to electrical shock or burns when normal disconnect methods are used. Exposed pin contacts shall not be energized (hot) after being disconnected from the socket contacts.

* 4.5 Radiation. The design of all equipment for which a federal standard exists under the Code of Federal Regulations (CFR), Title 21, Chapter I, Parts 1000 - 1050, on the Radiation Control for Health and Safety Act of 1968, shall conform to the appropriate federal standard.

4.5.1 Microwave and rf radiation. All electronic equipment or electrical devices capable of emitting microwave or rf radiation between 300 KHz and 100 GHz shall be so designed, fabricated, shielded and operated as to avoid overexposure of personnel. In areas where unintended radiation levels exist, equipment design and installation in any unrestricted area accessible to personnel shall meet the requirements of ANSI C95.1. Shields, covers, doors, etc, which when opened or removed will allow microwave and rf radiation to exceed the above, shall be provided with nonbypassable interlocks.

4.5.2 X radiation. All electronic or electrical devices capable of producing X radiation shall be so designed, fabricated, shielded and operated as to keep personnel exposure as low as reasonably achievable. For equipment and installation design, shielding requirements shall be maintained at all times which limit radiation levels to not greater than 2 milliroentgens (mr) in any one hour and 100 mr in any 7 consecutive days at the operator position or within 5cm from the equipment (whichever is closer) in any unrestricted area accessible to personnel. In addition, these levels shall be reduced whenever necessary to ensure that exposed personnel never receive an absorbed dose to the whole body or any critical organ in excess of 125 millirem per calendar quarter or 500 millirem per year. Other exposure shall be based on application criteria and limits as required by Nuclear Regulatory Commission Rules and Regulations, CFR, Title 10, Chapter I, Part 20; OSHA Regulations, CFR, Title 29, Chapter XVII,Part 1910.96; and FDA Regulation, CFR, Title 21, Chapter I, Subchapter J, Radiological Health. Equipment which, when shields, covers, doors, etc, are removed, will allow X radiation to exceed 2.0 mr per hour shall be provided with nonbypassable interlocks.

* 4.5.3 Laser radiation. Laser equipment and system design, installation, and operational and maintenance procedures shall conform to CFR, Title 21, Chapter I, Part 1040. If Title 21 cannot be met because of operational requirements, an exemption shall be requested from the procuring activity and applicable military laser safety regulations shall be used as a design requirement.

4.6 Mechanical. The design of the equipment shall provide personnel maximum access and safety while installing, operating, and maintaining the equipment. Equipment design shall include provisions to prevent accidental pulling out of drawers or rack mounted equipment components. Suitable protection shall be provided to prevent contact with moving mechanical parts such as gears, fans, and belts when the equipment is complete and operating. Sharp projections on cabinets, doors, and similar parts shall be avoided. Doors or hinged covers shall be rounded at the corners and provided with stops to hold them open.

4.6.1 Mechanical interconnection. The design shall provide positive means to prevent the inadvertent reversing or mismating of fittings; couplings; fuel, oil, hydraulic, and

pneumatic lines; and mechanical linkage. When prevention of mismating by design consideration is not feasible, coding or marking shall be employed when approved by the procuring activity. Coding and marking will not be approved as a substitute for proper design or items involving explosive,emergency, or safety critical systems.

4.6.2 Power switch location. Equipment power switches shall be so selected and located that accidental contact by personnel will not place equipment in operation.

4.6.3 Cathode ray tubes. Provision shall be incorporated to protect personnel from injury due to implosion of cathode ray tubes.

4.7 Equipment safety markings. Danger, caution, etc, signs, labels and markings shall be used to warn of specific hazards such as voltage, current, thermal, or physical. The signs, labels, and markings shall be as permanent as the normal life expectancy of the equipment on which they are affixed. Guards, barriers, and access doors, covers or plates shall be marked to indicate the hazard which may be reached upon removal of such devices. When possible, marking shall be located such that it is not removed when the barrier or access door is removed. Additionally, hazards internal to a unit shall be marked adjacent to hazards if they are significantly different from those of surrounding items. Such a case would be a high voltage terminal in a group of low voltage devices.

a. Physical hazards shall be marked with color codes in accordance with ANSI Z53.1 where applicable to electronic equipment.

b. For potentials between 70 and 500 volts, warning signs or labels shall be in accordance with ANSI Z35.1, Class II, and ANSI Z35.4, and shall read, as a minimum, "*Caution* – (Insert maximum voltage applicable) *Volts.*"

c. For potentials in excess of 500 volts, warning signs or labels shall be in accordance with ANSI Z35.1, Class I and ANSI Z35.4, and shall read, as a minimum, "*Danger – High Voltage* – (Insert maximum voltage applicable) *Volts.*"

d. Microwave or rf radiation warning signs shall be in accordance with ANSI Z35.1 and ANSI C95.2. Labels shall be provided on all radiation shields to warn personnel of the radiation hazards involved upon removal thereof. Any item which can emit radiation levels in excess of those specified in paragraph 4.5.1 shall be labeled. Minimum safe clearance distances shall be clearly marked. Warning signs shall be posted in all areas having electronic equipment designed to operate between 300 KHz and 100 GHz with intended electromagnetic radiation levels exceeding those in paragraph 4.5.1.

e. (1) Laser labels shall be in accordance with CFR, Title 21, Chapter I, Part 1040.

(2) Military exempt laser labels: A permanent label shall be affixed on all military laser systems that have been certified exempt from CFR, Title 21, Part 1040 (Performance Standards for Light-Emitting Products), which reads:

CAUTION

This electronic product has been exempted from FDA radiation safety performance standards, prescribed in the Code of Federal Regulations, Title 21, Chapter I, Subchapter J, pursuant to Exemption No. 76 EL-01 DOD issued on 26 July 1976. This product should not be used without adequate protective devices or procedures.

f. Shields which protect personnel from X radiation shall be labeled in accordance with CFR, Title 10, Chapter I, Part 20.

g. Coding for accident prevention tags shall be in accordance with ANSI Z35.2.

h. The marking or labeling of commodities containing radioactive materials shall be in accordance with CFR, Title 10, Chapter I, Part 20.

i. Ionizing radiation hazard symbols shall be in accordance with ANSI N2.1.

4.8 Hazardous and restricted materials

4.8.1 Gases or fumes. The materials, as installed in the equipment and under service conditions specified in the equipment specification, shall not liberate gases which combine with the atmosphere to form an acid or corrosive alkali, nor shall they liberate toxic or corrosive fumes which would be detrimental to the performance of the equipment or health of personnel. The materials also shall not liberate gases which will produce an explosive atmosphere.

4.8.2 Mercury. Materials and parts containing mercury shall not be used unless use of mercury is specifically required or approved by the procuring activity.

4.8.3 Radioactive materials. Use of radioactive materials shall conform to Nuclear Regulatory Commission regulations and shall require approval of the procuring activity. Radium shall not be used to achieve self-luminosity.

4.8.4 Glass fibers. Glass fiber materials shall not be used as the outer surface or covering on cables, wire or other items where they may cause skin irritation to operating personnel. This does not preclude the use of military specification wire and cable. When maintenance procedures require access to glass fibers, such as insulation, a proper caution note shall be provided.

5. Information for guidance only

5.1 Human engineering. Human engineering factors affecting safety should be considered when establishing general or detailed design criteria. Rigorous detailed operational or maintenance procedures are not acceptable substitutes for an inherently safe design. Hazard and safety requirements of MIL-STD-1472 should be used as a guide.

5.2 Electrical. Proper instructions in accident prevention and first-aid procedures should be given to all persons engaged in electrical work to fully inform them of the hazards involved.

5.2.1 Shock hazards. Current rather than voltage is the most important variable in establishing the criterion for shock intensity. Three factors that determine the severity of electrical shock are: (1) quantity of current flowing through the body; (2) path of current through the body; and (3) duration of time that the current flows through the body. The voltage necessary to produce the fatal current is dependent upon the resistance of the body, contact conditions, and the path through the body. See table 1-I. Sufficient current passing through any part of the body will cause severe burns and hemorrhages. However, relatively small currents can be lethal if the path includes a vital part of the body, such as the heart or lungs. Electrical burns are usually of two types, those produced by heat of the arc which occurs when the body touches a high-

voltage circuit, and those caused by passage of electrical current through the skin and tissue. While current is the primary factor which determines shock severity, protection requirements are based upon the voltage involved to simplify their application. In cases where the maximum current which can flow from a point is less than the values shown in table 1-I for reflex action, protection requirements may be relaxed.

TABLE 1-I. Probable effects of shock.

Current Values (Milliamperes)		Effects
AC 25 Hz TO 400 Hz	DC	
0-1	0-4	Perception
1-4	4-15	Surprise
4-21	15-180	Reflex action
21-40	80-160	Muscular inhibition
40-100	160-300	Respiratory block
Over 100	Over 300	Usually fatal

5.2.2 Insulation of controls. All control shafts and bushings thereof should be grounded whenever practicable. Alternatively, the control knobs or levers and all attachment screws that can be contacted during use should be electrically insulated from the shaft.

5.2.3 Grounding to chassis. Ground connection to an electrically conductive chassis or frame should be mechanically secured by soldering to a spotwelded terminal lug or to a portion of the chassis or frame that has been formed into a soldering lug, or by use of a terminal on the ground wire and then securing the terminal by a screw, nut, and lockwasher. The screw should fit in a tapped hole in the chassis or frame or it should be held in a through-hole by a nut. When the chassis or frame is made of steel, the metal around the screw hole should be plated or tinned to provide a corrosion resistant connection. When aluminum alloys are used, the metal around the grounding screw or bolt hole may be covered with a corrosion resistant surface film only if the resistance through the film is not more than 0.002 ohm. Hardware used for mounting of meters, switches, test points, etc, should be grounded, whenever possible.

5.2.4 Accidental contact. Suitable protective measures are defined in table 1-II.

5.2.4.1 High current protection. Power sources capable of supplying high current can be hazardous regardless of the voltage at which they operate because of the arcing and heat generated if an accidental short circuit occurs. All power buses supplying 25 amperes or over should be protected against accidental short circuiting by tools, jewelry or removable conductive assemblies. This may be accomplished by one or more of the following:

a. Use of guards and barriers,

b. Sufficient space separation to prevent short circuits,

c. Caution - warning signs.

5.2.4.2 Interlocks. Various equipment designs require different approaches to the use of interlocks. Interlock use does not modify any other requirements of this standard and must be consistent with equipment or system specifications. Equipment sub-assemblies operating in excess of 500 volts should be considered guarded from accidental contact only if they are completely enclosed from the remainder of the equipment and are separately protected by nonbypassable interlocks. (An example of an equipment where such compartmentalization is desirable is a display unit which utilizes a high voltage power supply for a cathode ray tube.) Modularized or sealed high voltage assemblies which are opened only at depot level are exempt from interlocking requirements when approved by the procuring activity.

5.2.4.3 Permanent terminations. Terminations such as soldered connections to transformers, connectors, splices, etc, which are normally permanent and not used during routine maintenance testing, may be protected by permanent insulation such as shrink sleeving, tubing, insulating shields, etc, provided the material is rated for the potential exposed voltage.

5.3 Mechanical. Design of rack-mounted equipment should maintain the center of gravity as low as possible to minimize tipping over.

5.4 Marking. MIL-HDBK-600 references known electronic items which require marking and may be used as a guide.

5.5 Materials. Certain chemicals have been identified in the Occupational Safety and Health Act (OSHA) as cancer-producing substances (carcinogens). Before using any materials which might contain these chemicals, they should be evaluated in accordance with the CFR, Title 29, Chapter XVII, Part 1910.

TABLE 1-II. Suitable protective measures. 1/

Voltage range	Type of protection 2/								
				Marking		Interlocks		Discharge devices	
	None 3/	Guards and barriers (4.4.3.1	Enclosures (4.4.3.2 4.4.4.1)	Caution (4.7b)	Danger (4.7c)	Bypassable (4.4.4.1b)	Non- 4/ bypassable (4.4.4.1c)	Automatic (4.4.5.1)	Shorting Rods (4.4.5.2)
0 - 30 Volts	X								
>30 - 70 Volts	X							X	
>70 - 500 Volts		X		X		X		X	X
>500 Volts			X		X		X	X	X

1/ Table is for reference only. See applicable paragraph for requirements.

2/ Confine the application of headings to voltage ranges indicated. More than one option may be available on design requirements.

3/ Although no specific requirements exist for servicing 0-70 volts, designs should be reviewed for possible hazards in accordance with table 1-I.

4/ Designs may use nonbypassable interlock applications below 500 volts, but the intent here is to imply complete enclosure.

REQUIREMENT 4

FUNGUS-INERT MATERIALS

1. Purpose. This requirement identifies those materials which are acceptable non-nutrients of fungus and establishes conditions under which fungus nutrient materials are acceptable.

2. Documents applicable to Requirement 4:

MIL-T-152	Treatment, Moisture and Fungus Resistant, of Communications, Electronic, and Associated Electrical Equipment
MIL-V-173	Varnish, Moisture and Fungus Resistant (For Treatment of Communications, Electronic, and Associated Equipment)
MIL-STD-810	Environmental Test Methods and Engineering Guidelines
29 CFR 1910	

3. Definitions

3.1 Fungus-inert material. A material which, in all modified states and grades, is not a nutrient to fungi.

3.2 Fungicide. A substance that destroys or inhibits the growth of fungi.

4. Requirements

4.1 Preferred materials. Fungus-inert materials listed in Group I of table 4-I are preferred for use. These materials need not be tested for fungus resistance prior to use. The appearance of a particular material in table 4-I does not constitute approval for its use except from the viewpoint of the resistance of the material to fungi.

4.2 Acceptable materials. Those materials listed in Group II of table4-I may be used, provided it has been demonstrated that they meet the requirements of paragraph 4.4. When materials are compounded with a permanently effective fungicide in order to meet the fungus test requirement, there shall be no loss of the original electronic or physical properties required by the basic material specification. Fungicides containing mercury shall not be used.

4.3 Hermetically sealed applications. Fungus nutrient materials may be used untreated within hermetically sealed enclosures.

4.4 Fungus testing. Group II materials shall be subjected to the fungus test specified in MIL-STD-810, Method 508, for a period of 28 days. Certification by a qualified laboratory or by the material producer, based on test data on record that the material meets Grade O or Grade 1 requirements of table 508-I, Method 508, MIL-STD-810, is sufficient evidence of acceptability.

TABLE 4-I. Fungi susceptibility of materials.

Group I - Fungus-inert materials (Fungus-inert in all modified states and grades)	
Acrylics 1/	Polyamide
Acrylonitrile-styrene	Polycarbonate
Acrylonitrile-vinyl-chloride copolymer	Polyester-glass fiber laminates
Asbestos	Polyethylene, high density (above 0.940)
Ceramics	Polyethylene terephthalate
Chlorinated polyester	Polyimide
Fluorinated ethylenepropylene copolymer (FEP)	Polymonochlorotrifluoroethylene
Glass	Polypropylene
Metals	Polystyrene
Mica	Polysulfone
Plastic laminates:	Polytetrafluoroethylene
Silicone-glass fiber	Polyvinylidene chloride
Phenolic-nylon fiber	Silicone resin
Diallyl phthalate	Siloxane-polyolefin polymer
Polyacrylonitrile	Siloxane polystyrene
Group-II - Fungus nutrient materials (May require treatment to attain fungus resistance)	
ABS (acrylonitrile-butadiene-styrene)	Polyethylene, low and medium density (0.940 and below)
Acetal resins	Polymethyl methacrylate
Cellulose acetate	Polyurethane (the ester types are particularly susceptible)
Cellulose acetate butyrate	Polyricinoleates
Epoxy-glass fiber laminates	Polyvinyl chloride
Epoxy-resin	Polyvinyl chloride-acetate
Lubricants	Polyvinyl fluoride
Melamine-formaldehyde	Rubbers, natural and synthetic
Organic polysulphides	Urea-formaldehyde
Phenol-formaldehyde	
Polydichlorostyrene	

1/ Literature shows that under certain conditions polyamides may be attacked by selective micro-organisms. However, for military applications, they are considered Group I.

5. Information for guidance only

5.1 Process-related materials. Processing materials to be tested for fungus resistance in accordance with paragraph 4.4, such as paint, ink, coatings, adhesives, lubricants, viscous damping fluids, silicone grease, etc, should be prepared in the form of 50 mm squares or circles no more than 1.6 mm thick for testing. Liquid or paste materials should be prepared by impregnating to saturation a sterile sample of glass fabric.

5.2 Parts treatment. When treatment of parts is required to form fungus-resistant materials, a moisture and fungus proofing (MFP) varnish conforming to MIL-V-173 may be applied in accordance with MIL-T-152 after the part is cleaned. The MFP varnish should not be applied to any part where the treatment will interfere with performance.

5.3 Carcinogens. Certain chemicals have been identified in the Occupational Safety and Health Act (OSHA) as cancer-producing substances (carcinogens). Before using any materials which might contain these chemicals, they should be evaluated in accordance with the Code of Federal Regulations, Title 29, Chapter XVII, Part 1910. Consideration of the toxicity of a substance should be given prior to material selection.

REQUIREMENT 6

BEARINGS

1. Purpose. This requirement establishes criteria for the selection and application of bearings.

2. Documents applicable to Requirement 6:

FF-B-171	Bearings, Ball, Annular (General Purpose)
FF-B-185	Bearings, Roller, Cylindrical; and Bearings, Roller, Self-Aligning
FF-B-187	Bearing, Roller, Tapered
FF-B-195	Bearings, Sleeve, (Bronze, Plain or Flanged)
MIL-B-3990	Bearing, Roller, Needle, Airframe, Anti-Friction, Inch
MIL-B-5687	Bearing, Sleeve, Washers, Thrust, Sintered, Metal Powder Oil Impregnated, General Specification for
MIL-B-8942	Bearings, Plain, TFE Lined, Self-Aligning
MIL-B-8943	Bearings, Journal-Plain and Flanged, TFE Lined
MIL-B-8948	Bearing, Plain Rod End, TFE Lined, Self-Aligning
MIL-B-13506	Bearing, Sleeve (Steel Backed)
MIL-B-17380	Bearing, Roller, Thrust
MIL-B-81744	Barrier Coating Solution, Lubricant Migration Deterring
MIL-B-81793	Bearing, Ball, Annular, for Instruments and Precision Rotating Components
MIL-B-81934	Bearing, Sleeve, Plain and Flanged, Self-Lubricating
MIL-B-81936	Bearing, Plain, Self-Aligning (BeCu, CRES Race)
MIL-STD-1334	Process for Barrier Coating of Anti-Friction Bearings

3. Definitions. Not applicable.

4. Requirements

4.1 Selection and application. Bearings best suited to meet the physical, functional, environmental and service life requirements of the application shall be selected from those conforming to one or more of the specifications listed below. Replacement of the bearing shall be possible without the use of special tools unless such provisions would adversely affect the proper functioning or service life of the bearing.

FF-B-171	MIL-B-5687	MIL-B-17380
FF-B-185	MIL-B-8942	MIL-B-81793
FF-B-187	MIL-B-8943	MIL-B-81934
FF-B-195	MIL-B-8948	MIL-B-81936
MIL-B-3990	MIL-B-13506	

4.2 Lubricant. Adequate lubricant shall be provided either within the bearing or externally in the form of oil reservoirs or grease relubrication facilities except as

noted in 4.3. Where lubricant replenishment is required, precautions shall be taken to prevent purged or lost lubricant from entering and adversely affecting the operation of the electronic equipment. Where bearings coated with preservative are installed in closed housings, the preservatives shall be compatible with the lubricant used in the assembly.

4.3 Unlubricated bearings. Unlubricated bearings or bushings may be used only in applications where the presence of a lubricant would be undesirable or detrimental and the functional, environmental and service life requirements can be met in this condition.

4.4 Barrier coating. Bearings requiring a barrier coating shall be coated in accordance with MIL-STD-1334. Barrier coating material shall conform to MIL-B-81744.

4.5 Seals and shields. All rolling element bearings shall be adequately protected by seals or shields on the bearing or installed in housings which provide adequate shielding to prevent foreign matter from entering the bearing.

4.6 Electrical grounding. Ball and roller bearings used for rotating an electrically energized equipment shall be electrically shunted to avoid current flow through the bearings.

4.7 Alignment. Bearings shall be located to ensure proper shaft alignment and support.

5. Information for guidance only

5.1 Self-lubricating bearings. Permanently lubricated bearings or bushings of plastic, metallic-plastic combinations, or all metallic materials with or without dry film lubricants may be used provided wear products produced during operation will not cause or contribute to failure of the electronic equipment or bearings.

5.2 Unlubricated bearings. For selection of low friction, long life, unlubricated bearings refer to MIL-B-8942, MIL-B-8943, and MIL-B-8948.

REQUIREMENT 10

ELECTRICAL CONNECTORS

1. Purpose. This requirement establishes criteria for the selection and application of electrical connectors.

2. Documents applicable to Requirement 10 :

MIL-J-641	Jack, Telephone, General Specification for
MIL-P-642	Plug, Telephone, and Accessory Screws, General Specification for
MIL-C-10544	Connector, Plug and Receptacle (Electrical, Audio, Waterproof, Ten Contact, Polarized)
MIL-C-12520	Connector, Plug and Receptacle (Electrical, Waterproof), and Accessories, General Specification for
MIL-C-55116	Connectors, Miniature, Audio, Five-Pin
MIL-C-55181	Connectors, Plug and Receptacle, Intermediate Power (Electrical) (Waterproof) Type MW, General Specification for
MIL-A-55339	Adapters, Connector, Coaxial, Radio Frequency (Between Series and Within Series)
MIL-C-83503	Connectors, Electrical, Flat Cable, and/or Printed Wiring Board, Nonenvironmental, General Specification for
MIL-STD-1353	Electrical Connectors, Plug-In Sockets and Associated Hardware, Selection and Use of
MIL-STD-1646	Servicing Tools for Electric Contacts and Connections, Selection and Use of
MIL-STD-2120	Connectors, Electromagnetic Interference (EMI) Filter Contact
EIA-297-A	Cable Connectors for Audio Facilities for Radio Broadcasting

3. Definitions. Not applicable.

4. Requirements

4.1 Selection. Selection and use of electrical connectors shall be in accordance with MIL-STD-1353 and as specified herein. Intended use information contained in the individual connector specifications shall be considered prior to making connector selections. Contact crimp, installing and removal tools shall be in accordance with MIL-STD-1646 or as specified in the individual connector specifications. However, contractors may use tooling as recommended by the contact or tooling manufacturer provided that the finished crimp meets all of the performance requirements of the contact and connector specification. The variety of these tools required within a system shall be kept to a minimum. Maintenance instructions and other data supplied by the contractor shall list the military standard tools and contacts.

4.2 Audio frequency and communication connectors, special purpose. Connectors conforming to MIL-C-10544 or MIL-C-55116 shall be used in audio frequency applications, such as head sets and chest sets, excluding pilots' helmets. For low level, three wire and audio input circuits in fixed plant nontactical sound equipment, connectors conforming to EIA-297-A shall be used.

4.3 Connectors with thermocouple contacts. All connectors used in conjunction with thermocouples shall have their contact materials identified by one of the following methods:

a. Nameplate securely attached to each connector half or mounted on the panel-mounted receptacles.

b. Insulation sleeving or other markers designed for attachment around wire bundles. Markers shall be attached adjacent to the plug. Contact materials shall be identified with abbreviations in accordance with table 10-I.

TABLE 10-I. Abbreviations for thermocouple materials.

Chromel	CR	Cobalt	CO
Alumel	AL	Tungsten Rhenium	W RE
Iron	FE	Tungsten	W
Constantan	CN	Iridium	IR
Copper	CU	Rhodium	RH
Platinum	PT	Iridium Rhodium	IR RH
Platinum Rhodium	PT RH	Molydbenum	MO
Rhenium	RE	Gold	AU

4.4 Heavy duty connectors

4.4.1 Power connectors (40-200 amperes). All power connectors for any ground application shall conform to Section 102 of MIL-STD-1353 and shall be used with heavy duty jacketed cable as specified on the insert standards.

4.4.2 General purpose and shipboard. Connectors for general purpose heavy duty applications and shipboard power applications shall conform to Section 102 of MIL-STD-1353. Connectors used for external applications shall be pressurized and waterproof in the mated and unmated condition in accordance with the requirements of Classes C or L. Connectors used internally (within a protective enclosure such as a shelter) may be in accordance with Class provided waterproofing or pressurization is not a requirement for the application.

4.4.3 Right angle power and control (Army only). In application where right angle bend is required, center lock screw multicontact connectors shall conform to MIL-C-12520 or MIL-C-55181, as applicable.

4.5 General utility connectors. Polarized connectors are the preferred styles and shall be used where automatic grounding must be provided to insure safety to equipment and personnel. Connectors for general utility power applications shall conform to Section 106 of MIL-STD-1353.

4.6 Plugs and jacks (telephone type). Telephone type jacks and plugs shall conform to MIL-J-641 and MIL-P-642.

4.7 Test jacks. Test jacks shall conform to Section 105 of MIL-STD-1353. Jacks or receptacles for use as rf test points shall be selected in accordance with paragraph 4.8.

4.8 Rf connectors. Rf connectors shall conform to Section 200 of MIL-STD-1353. Adapters used with rf connectors shall conform to MIL-A-55339.

4.9 Connectors for printed wiring. Printed circuit connectors shall conform to Section 104 MIL-STD-1353.

* 4.10 Connector wiring. Multiple conductors may terminate in a contact provided the sum of the cross sectional areas of the conductors does not exceed the maximum cross sectional area for which the contact is rated. Not more than one wire shall be routed through any hole in the grommet of an environmentally sealed connector.

4.11 Extra contacts. The following requirements are applicable to all articles of equipment, except those in which it is unlikely that additional circuits will be required.

4.11.1 Quantity and location. Unused connector contacts or contact positions for external circuits shall be provided for future use, and shall be located on the periphery (outer contacts) of the connector. The minimum quantity shall be as specified below:

Total number of used contacts in connector	Unused contacts or contact positions required (min)
1 thru 3	1 (optional)
4 thru 25	2
26 thru 100	4
101 or over	6

4.11.2 An extra connector shall not be used to meet this requirement without the approval of the procuring activity.

4.11.3 Size and rating of extra contacts. The size and rating of extra contacts shall be compatible with other contacts within the connector.

4.11.4 Crimp contact connectors. When crimp contact environmentally sealed connectors are used, all contact positions shall be filled with contacts.

4.11.5 Sealing plugs. Sealing plugs shall be inserted in the grommet holes of unused contacts in environmentally sealed connectors.

4.11.6 Potted connectors. For potted connectors, each unused contact shall have a maximum gauge wire of 150 mm minimum length attached and identified with the contact designation for future use. For connectors external to the unit, the wire end shall be suitably capped to prevent moisture from entering the connector.

4.12 Protective measures. All unmated connectors shall be protected with metal or plastic caps or otherwise suitably protected during maintenance, storage and shipment. Protective caps specified by military specifications or military standards and designed for mating with specific connectors shall be used. Unmated connectors which may contain electrically "hot" circuits while in environmentally hazardous areas shall be covered with moistureproof and vaporproof caps. Connectors on enclosed cabinet mounted equipment need not be provided with protective caps unless an environmental hazard exists.

4.13 Connectors for flat conductor cable. Connectors for use with flexible flat conductor cable shall conform to MIL-C-83503.

4.14 Fireproof connectors. Fireproof and firewall connectors shall be class K and shall conform to Section 101 of MIL-STD-1353. Where it is necessary to maintain electrical continuity for a limited time under continuous flame, both the receptacle and mating plug shall be class K. If flame integrity only is necessary without the need for electrical continuity, a class K receptacle shall be used, but the mating plug may be of any type and class. In all cases, the plug and receptacle shall be environment resisting.

4.15 Filter pin connectors. Electrical connectors incorporating filter pins shall be considered for use only when conventional electrical filters are not acceptable. When used, filter pin connectors shall conform to MIL-STD-2120.

5. Information for guidance only. Not applicable.

REQUIREMENT 11

INSULATING MATERIALS, ELECTRICAL

1. Purpose. This requirement establishes criteria for the selection and application of electrical insulating materials.

2. Documents applicable to Requirement 11:

L-P-516	Plastic Sheet and Plastic Rod, Thermosetting, Cast
MIL-I-10	Insulating Compound, Electrical, Ceramic, Class L
MIL-M-14	Molding Plastics and Molded Plastic Parts, Thermosetting
MIL-P-79	Plastic Rod and Tube, Thermosetting, Laminated
MIL-I-631	Insulation, Electrical, Synthetic - Resin Composition, Nonrigid
MIL-P-997	Plastic Material, Laminated, Thermosetting, Electrical Insulation, Sheets, Glass Cloth, Silicone Resin
MIL-I-3158	Insulation Tape, Electrical, Glass-Fiber (Resin-Filled), and Cord, Fibrous-Glass
MIL-I-3190	Insulation Sleeving, Electrical, Flexible, Coated, General Specification for
MIL-I-3825	Insulating Tape, Electrical, Self-Fusing: For Use in Electronics, Communications, and Allied Equipment
MIL-I-7444	Insulation Sleeving, Electrical, Flexible
MIL-T-13020	Tape, Rubber, Unvulcanized, Splicing and Molding (Tapes TL-317/U and TL-318/U)
MIL-P-15037	Plastic Sheet, Laminated, Thermosetting, Glass-Cloth, Melamine-Resin
MIL-P-15047	Plastic Sheets, Laminated, Thermosetting, Nylon Fabric Base, Phenolic-resin
MIL-I-15126	Insulation Tape, Electrical, Pressure Sensitive Adhesive and Pressure Sensitive Thermosetting Adhesive
MIL-I-17205	Insulation Cloth and Tape, Electrical, Glass Fiber, Varnished
MIL-P-18177	Plastic Sheet, Laminated, Thermosetting, Glass Fiber Base, Epoxy-Resin
MIL-I-18746	Insulation Tape, Nonadhering, Glass Fabric, Polytetrafluoroethylene Coated
MIL-P-19161	Plastic Sheet, Laminated, Glass Cloth Polytetrafluoroethylene Resin
MIL-I-19166	Insulation Tape, Electrical, High-Temperature, Glass Fiber, Pressure Sensitive
MIL-I-22076	Insulation Tubing, Electrical, Nonrigid, Vinyl, Very Low Temperature Grade
MIL-I-23053	Insulation Sleeving, Electrical, Heat-Shrinkable, General Specification for
MIL-I-23264	Insulators, Ceramic, Electrical and Electronic, General Specification for
MIL-I-23594	Insulation Tape, Electrical; High Temperature Polytetra-fluoroethylene, Pressure-Sensitive
MIL-I-24092	Insulating Varnish, Electrical, Impregnating, Solvent Containing
MIL-I-24204	Insulation, Electrical, High Temperature, Bonded, Synthetic Fiber Paper
MIL-I-24391	Insulation Tape, Electrical, Plastic, Pressure Sensitive
MIL-I-46852	Insulation Tape, Electrical, Self-Adhering, Unsupported Silicone Rubber

ASTM D3295-81 PTFE Tubing, Specification for
29 CFR 1910

3. Definitions. Not applicable.

4. Requirements

4.1 Ceramics. Ceramic compounds shall conform to MIL-I-10. Ceramic insulators shall conform to MIL-I-23264.

4.2 Electrical tape. Tape shall be selected from the types included in MIL-I-3158, MIL-I-3825, MIL-T-13020, MIL-I-15126, MIL-I-17205, MIL-I-18746, MIL-I-19166, MIL-I-23594, MIL-I-24391, and MIL-I-46852.

4.3 Sleeving. Sleeving shall conform to MIL-I-631, MIL-I-3190, MIL-I-7444, MIL-I-22076, MIL-I-23053, or ASTM D3295.

4.4 Plastic, thermosetting, cast. When used for electrical insulation, parts fabricated from cast thermosetting plastic materials shall be in accordance with L-P-516.

4.5 Plastic, thermosetting, laminated. Materials selected shall conform to MIL-P-79, MIL-P-997, MIL-P-15037, MIL-P-15047, MIL-P-18177, MIL-P-19161, or MIL-I-24204. The preferred base is glass cloth. Electrical insulators fabricated from laminated thermosetting-plastic sheets, plates, rods and tubes (except transparent plastics) shall be treated after all machining and punching operations with a suitable moisture barrier unless the plastic has a moisture absorption of 1.0 percent or less or is used in a hermetically sealed container.

4.6 Plastic, thermosetting, molded. Materials used to mold electrical insulators shall conform to MIL-M-14. Molded parts which undergo subsequent machining shall be vacuum impregnated with a suitable moisture barrier material and dried after all surface-breaking operations have been completed. Cotton and linen shall not be used as filler material in any electrical insulator. Materials having moisture absorption of 1.0 percent or less, and those used in hermetically sealed containers, need not be impregnated.

4.7 Varnish, insulating. Insulating varnish shall conform to MIL-I-24092.

4.8 Polyvinyl chloride. Polyvinyl chloride insulating materials shall not be used in aerospace applications.

5. Information for guidance only

5.1 Insulating materials, electrical. Insulating materials should be selected based on meeting or exceeding the use requirements, such as:

a. Temperature endurance
b. Moisture absorption and penetration
c. Fungus resistance
d. Dielectric strength
e. Dielectric constant
f. Mechanical strength
g. Dissipation factor
h. Ozone resistance

5.2 Carcinogens. Certain chemicals have been identified in the Occupational Safety and Health Act (OSHA) as cancer-producing substances (carcinogens). Before using any materials which might contain these chemicals, they should be evaluated in accordance with the Code of Federal Regulations,Title 29, Chapter XVII, Part 1910. Consideration of the toxicity of a substance should be given prior to material selection.

REQUIREMENT 17

PRINTED WIRING

1. Purpose. This requirement established criteria for the design and treatment of printed wiring assemblies.

2. Documents applicable to Requirement 17:

MIL-P-13949	Plastic Sheet, Metal-Clad (For Printed Wiring Boards), General Specification for
MIL-C-28809	Circuit Card Assemblies, Rigid, Flexible, and Ridgid-Flex
MIL-A-28870	Assemblies, Electrical Backplane, Printed Wiring, General Specification for
MIL-I-46058	Insulating Compound, Electrical (For Coating Printed Circuit Assemblies)
MIL-P-46843	Printed Wiring Assemblies
MIL-P-50884	Printed Wiring, Flexible, and Rigid-Flex
MIL-P-55110	Printed Wiring Boards
MIL-STD-275	Printed Wiring for Electronic Equipment
MIL-STD-2118	Flexible and Rigid-Flex Printed Wiring for Electronic Equipment, Design Requirements for
MIL-STD-2119	Design Requirements for Printed Wiring Electrical Backplane Assemblies
ANSI/IPC-DW-425/11	Design and End Product Requirements for Discrete Wiring Boards/Plated-Through Hole Connection

3. Definitions. Not applicable.

4. Requirements

4.1 Rigid printed wiring and printed wiring boards. Rigid printed wiring and printed wiring boards for single-sided, double-sided, and multilayer printed wiring shall conform to MIL-STD-275 and MIL-P-55110. The materials used for single-sided, double-sided, and multilayer printed wiring boards shall conform to MIL-P-13949.

4.2 Rigid printed wiring assemblies. Rigid printed wiring assemblies consisting of rigid printed wiring boards on which separately manufactured parts have been added shall conform to MIL-C-28809. For Army missile weapon systems, MIL-P-46843 shall apply.

4.3 Conformal coating. When conformal coating is required, rigid printed wiring assemblies shall be conformally coated with a coating material which conforms to MIL-I-46058.

4.4 Flexible and rigid-flex wiring. Flexible and rigid-flex printed wiring shall conform to MIL-P-50884 and shall be designed in accordance with MIL-STD-2118.

4.5 Discrete wiring boards. Discrete wiring boards with plated-through holes shall be in accordance with ANSI/IPC-DW-425/11. Discrete wiring boards shall not be used for space application.

4.6 Backplane assemblies, printed wiring. Electrical backplane printed wiring assemblies shall conform to MIL-A-28870 and shall be designed in accordance with MIL-STD-2119.

5. Information for guidance only

5.1 Printed wiring board size. Whenever cost and technical requirements permit, preferred rigid printed wiring board sizes should be used. These board sizes will facilitate the development and use of standardized insertion and extraction tools. The preferred board sizes and thickness and extractor hole size and location are shown in figure 17-1.

Preferred-Thickness (Inch)
.062
.093
.125

BOARD NO.	PRINTED WIRING BOARD SIZE IN NOMINAL ± .015
A1	2.0 X 3.0
A2	2.0.X 4.5
A3	2.0 X 6.5
A4	2.0 X 8.0
B1	5.0 X 3.0
B2	5.0 X 4.5
B3	5.0 X 6.5
B4	5.0 X 8.0
C1	6.5 X 3.0
C2	6.5 X 4.5
C3	6.5 X 6.5
C4	6.5 X 8.0
D1	8.0 X 3.0
D2	8.0 X 4.5
D4	8.0 X 8.0

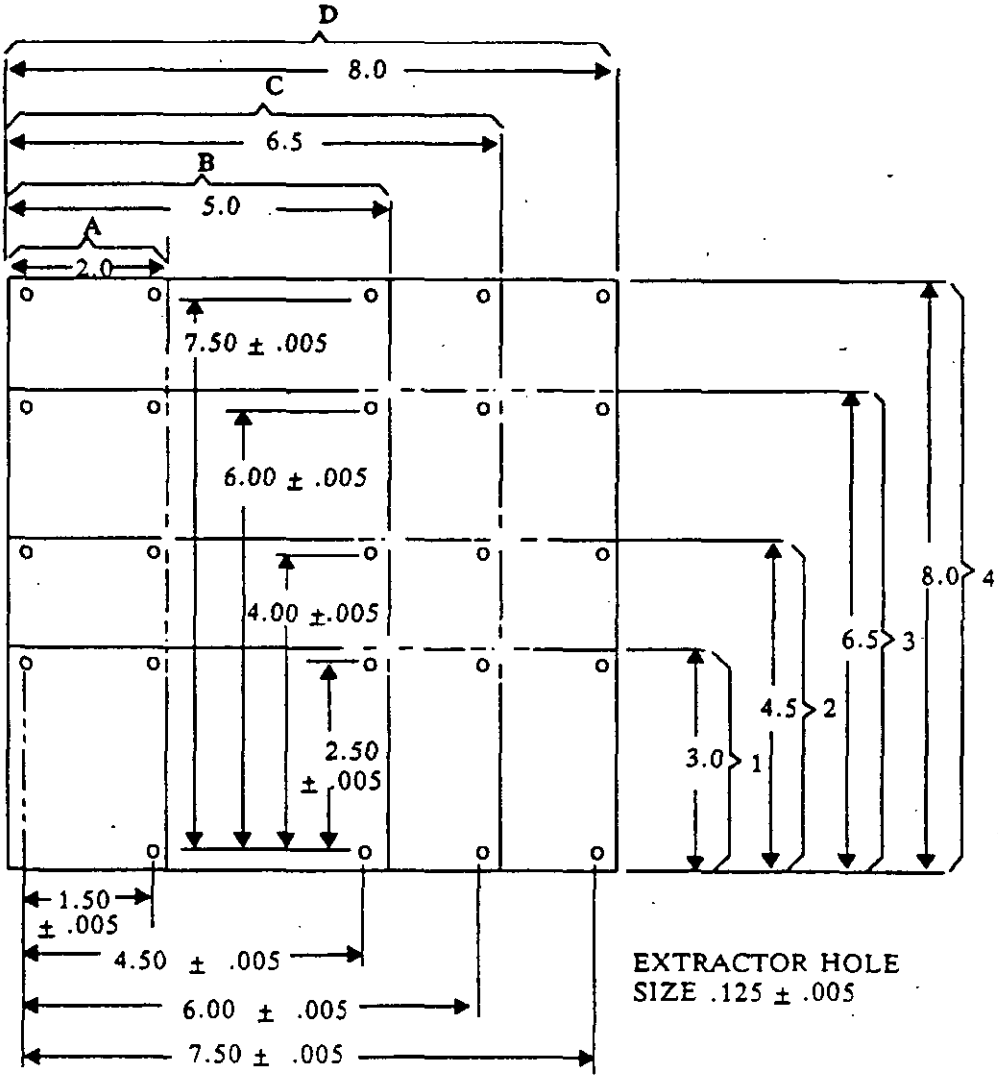

FIGURE 17-1. Preferred printed wiring board sizes.

REQUIREMENT 19

TERMINATIONS

1. Purpose. This requirement establishes criteria for the selection and application of terminations.

2. Documents applicable to Requirement 19:

MIL-T-7928	Terminals, Lug and Splice, Crimp-Style, Copper
MIL-T-15659	Terminal, Lug, Solder, Copper and Phosphor Bronze
MIL-T-55156	Terminals, Lug, Splices, Conductor; Screw Type, General Specification for
MIL-T-55164	Terminal Boards, Molded, Barrier, Screw Type, and Associated Terminal Board Lugs, General Specification for
MIL-STD-1277	Splices, Terminals, Terminal Boards, Binding Posts, Terminal Junction Systems, Wire Caps; Electrical
MS 27212	Terminal Boards, Assembly, Molded-in Stud, Electric

3. Definitions. Not applicable.

4. Requirements

4.1 Terminals

4.1.1 Lug terminals. Lug terminals shall conform to one of the following specifications, and wherever possible shall be selected from MIL-STD-1277.

MIL-T-7928	Crimp, Insulated and Noninsulated
MIL-T-15659	Solder
MIL-T-55156	Screw

4.1.2 Stud terminals, feed-through terminals, and binding posts. Stud terminals, feed-through terminals and binding posts shall be selected from MIL-STD-1277.

* 4.1.3 Number of wires per terminal or lug. The number of wires terminated in an individual terminal or lug shall not be greater than three. Multisection turret, bifurcated, or multi-hole lug terminals shall have not more than three wires per section, tong, or hole. In no case shall the total cross sectional area of the terminated wires exceed the cross sectional area capacity of the terminal or lug. If a greater number of wires is required than those specified herein, approval of the procuring activity shall be obtained.

4.2 Terminal boards. Terminal boards shall be selected from MIL-STD-1277.

4.2.1 Number of lugs per terminal. The maximum number of lugs to be connected to any one terminal on a terminal board shall be two for screw-type terminal boards covered by MIL-T-55164 and as specified in the detail specification sheets for stud-type terminal boards. Not more than four lugs shall be connected to any one terminal of a board covered by MS27212. Accessories such as stud connectors, straddle plates, jumpers and terminal board lugs shall be counted as lugs for this purpose.

4.3 Terminal junction systems. Terminal junction systems shall be selected from MIL-STD-1277.

5. Information for guidance only. Crimping of terminal lugs should be so accomplished that the connections will meet the resistance (voltage drop) and tensile strength requirements and tests of MIL-T-7928.

REQUIREMENT 20

WIRE, HOOKUP, INTERNAL

1. Purpose. This requirement establishes criteria for the selection and application of electrical internal hookup wire.

2. Documents applicable to Requirement 20:

QQ-W-343	Wire, Electrical, Copper (Uninsulated)
MIL-W-76	Wire and Cable, Hookup, Electrical, Insulated
MIL-W-5086	Wire, Electric, Polyvinyl Chloride Insulated, Copper or Copper Alloy
MIL-W-5845	Wire, Electrical, Iron and Constantan, Thermocouple
MIL-W-5846	Wire, Electrical, Chromel and/or Alumel, Thermocouple
MIL-W-5908	Wire, Electrical, Copper and Constantan, Thermocouple
MIL-W-16878	Wire, Electrical, Insulated, General Specification for
MIL-W-19150	Wire, Insulated, Hard Drawn Copper
MIL-W-22759	Wire, Electric, Fluoropolymer-Insulated, Copper or Copper Alloy
MIL-W-81044	Wire, Electric, Crosslinked Polyalkene, Crosslinked Alkane-Imide Polymer, or Polyarylene Insulated, Copper or Copper Alloy
MIL-W-81381	Wire, Electric, Polyimide Insulated, Copper or Copper Alloy
MIL-W-81822	Wire, Electrical, Solderless Wrap, Insulated and Uninsulated, General Specification for
MIL-STD-681	Identification Coding and Application of Hook-Up and Lead Wire

3. Definitions. Not applicable.

4. Requirements

4.1 Selection. Internal hookup wire shall be selected from the types and classes specified by the documents listed in table 20-I. For solderless wrap applications, wires shall be selected which are in accordance with MIL-W-81822.

4.1.1 MIL-W-76 shall be used for Army applications only.

4.1.2 MIL-W-16878 shall not be used for Air Force aerospace equipment.

4.1.3 MIL-W-22759 wire with only single polytetrafluoroethylene insulation used in Air Force space and missile applications shall require the approval of the procuring activity.

* 4.1.4 Wires with polyvinyl chloride insulation shall not be used in aerospace applications. Use of these wires in any other Air Force or Army Missile Command application requires prior approval of the procuring activity.

* 4.1.5 Silver plated copper wire shall not be used in applications involving Army missile systems.

TABLE 20-I. Wire, electrical.

Spec No.	Title	Spec Type or Class	CONSTRUCTION 1/ Conductor Material	Coating	Type	2/ Insulation Primary	Primary Cover	Jacket/ Topcoat	Max Cond Temp °C	Max rms Volts	Remarks
MIL-W-76	Wire and Cable Hook-up, Electrical Insulated	LW	Cu/A or CCW	Sn	S,Str	1	8,10, 13A 3/	8,10,13A 3/	80	300	See Note 4 For US Army use only
		MW								1000	
		HW								2500	
		HF				2A				1000	
MIL-W-5086	Wire, Electric, Polyvinyl Chloride Insulated, Copper or Copper Alloy	M5806/1						8		600	
		M5086/2	Cu/A	Sn				8, 11	105		
		M5086/4			Str	1		8		3000	
		M5086/5						9A	110	600	
		M5086/6	HSA	Ag							
		M5086/7	Cu/A	Sn				8	105		
MIL-W-16878	Wire, Electrical, Insulated	M16878/1	Cu/A HSA, CCW	Ag, Sn	S,Str	1	8,10,11	1,8,10,11	105	600	See Note 4
		M16878/2								1000	
		M16878/3								3000	
		M16878/4		Ag		3A		3A,3B,4A, 13B 3/	200	600	
		M16878/5								1000	
		M16878/6								250	
		M16878/7	Cu/A			6	4A,8,10, 11	4A,8,10, 11		600	
		M16878/8								1000	
		M16878/10		Sn		2A	8,10,11		75	600	
		M16878/11	Cu/A, CCW	Ag		4A		4A	200	1000	
		M16878/12								250	
		M16878/13									
		M16878/14	Cu/A	Ag,Sn	S,Str	2C			125	600	
		M16878/15		Sn						1000	
		M16878/16								600	
		M16878/17	Cu/A, HSA, CCW	Ag,Sn		1		8	105	3000	
		M16878/18								1000	
		M16878/19								3000	
		M16878/20		Ag		3B		3A,3B,4A, 13B 3/	200	250	
		M16878/21								600	
		M16878/22								1000	
		M16878/23		Ni		3A			260	250	
		M16878/24				3B				600	
		M16878/25				3A					
		M16878/26				3B				1000	
		M16878/27				3A					
		M16878/28				3B					
		M16878/29	Cu/A	Sn	Str	6			150	600	
		M16878/30								1000	
		M16878/31									
		M16878/32		Ag					200		
		M16878/33	Cu/A, CCW	Sn	S,Str	2A			75	600	
		M16878/34	Cu	Ag	Str	3B			200	1000	
		M16878/35		Ni					260		

TABLE 20-I. Wire, electrical. - Continued

Spec No.	Title	Spec Type or Class	CONSTRUCTION 1/ Conductor Material	Coating	Type	2/ Insulation Primary	Primary Cover	Jacket/ Topcoat	Max Cond Temp °C	Max rms Volts	Remarks
MIL-W-19150	Wire, Insulated, Hard Drawn Copper		Cu/H			2A		8			
MIL-W-22759	Wire, Electric, Fluoropolymer Insulated, Copper or Copper Alloy	M22759/9	Cu/A	Ag	Str	3A			200	1000	
		M22759/10		Ni					260		
		M22759/11		Ag					200	600	
		M22759/12		Ni					260		
		M22759/14		Sn		4A		9B	135		
		M22759/15	HSA	Ag							
		M22759/16	Cu/A	Sn		17			150		
		M22759/17	HSA	Ag							
		M22759/18	Cu/A	Sn							
		M22759/19	HSA	Ag		3A			260	1000	
		M22759/21		Ni					200	600	
		M22759/22		Ag					260		
		M22759/23		Ni				7			
		M22759/31									
		M22759/32	Cu/A	Sn		21			150		
		M22759/33	HSA	Ag					200		
		M22759/34	Cu/A	Sn					150		
		M22759/35	HSA	Ag				21	200		
		M22759/41	Cu/A	Ni							
		M22759/42	HSA								
		M22759/43	Cu/A	Ag							
MIL-W-81044	Wire, Electric, Crosslinked Polyalkene, etc, Insulated	M81044/12	Cu/A	Sn	Str	2B		9B	150	600	See application temp limitation on detail spec sheet
		M81044/13	HSA	Ag							
MIL-W-81381	Wire, Electric, Polyimide Insulated, Copper or Copper Alloy	M81381/7	Cu/A	Ag	Str	19		20	200	600	/11, /12, and /22 have a bright aromatic polyamide braid with clear finisher coatings on 8 AWG and larger
		M81381/8		Ni			4B				
		M81381/9	HSA	Ag							
		M81381/10		Ni							
		M81381/11	Cu/A	Ag							
		M18381/12		Ni							
		M81381/13	HSA	Ag							
		M81381/14		Ni							
		M81381/17	Cu/A	Ag							
		M81381/18		Ni							
		M81381/19	HSA	Ag							
		M81381/20		Ni							
		M81381/21	Cu/A	Sn					150		
		M81381/22									

TABLE 20-I. Wire, electrical. - Continued

NOTES:

1/

Conductor Code		Description
Material	Cu/A	Copper, annealed
	Cu/H	Copper, hard drawn
	CCW	Copper, covered steel
	HSA	High strength copper alloy
	Al	Aluminum
Coating	Sn	Tin
	Ag	Silver
	Ni	Nickel
Type	S	Solid
	Str	Stranded

2/

Insulation Code	Description
1	Polyvinyl chloride/extruded
2A	Polyethylene/extruded
2B	Polyalkene/cross-linked/extruded
2C	Polyethylene/cross-linked/modified/extruded
3A	Polytetrafluoroethylene/extruded (TFE teflon)
3B	Polytetrafluoroethylene/tape
3C	Polytetrafluoroethylene/mineral filled/extruded
4A	Fluorinated ethylene propylene/extruded (FEP teflon)
4B	Fluorinated ethylene propylene/dispersion
6	Silicone rubber/extruded
7	Polyimide lacquer (Pure ML)
8	Polyamide/extruded (Nylon)
9A	Polyvinylidene fluoride/extruded (Kynar)
9B	Polyvinylidene fluoride/extruded/cross-linked
10	Braid/synthetic yarn/lacquer impregnated
11	Braid/nylon/impregnated
13A	Braid/glass fiber/impregnated
13B	Braid/TFE coated glass fiber/TFE finish
17	ETFE fluoropolymer
19	Fluorocarbon/polyimide tape
20	Modified aromatic polyimide resin
21	Ethylene-tetrafluoroethylene/cross-linked/modified/extruded

3/ When specified on purchase order

4/ Various combinations of primary, primary cover, and jacket insulations, and unshielded, shielded, etc., constructions are available to meet application requirements. See detail wire specification.

4.2 Identification. Hookup wires in the equipment shall be, insofar as practicable, distinctly coded in color or numbered. Short hookup wire, 150 mm or less between termination points, need not be marked if the path of the short wire can be easily and visually traced. The unmarked wire must be specified on the drawing. Codes, when used, shall be in accordance with MIL-STD-681 or as otherwise agreed upon with the procuring activity. Numbers shall not be used where they would be difficult to read or trace, such as in compact assemblies.

4.3 Bare wire. Bare hookup wire shall be type S, soft or drawn and annealed, and coated, and shall conform to QQ-W-343. Bare hookup wire shall not be used unless insulated wire is impractical because of circuit characteristics or shortness of wire run.

4.4 Thermocouple wire. Selection of thermocouple wire shall be in accordance with MIL-W-5845, MIL-W-5846, or MIL-W-5908.

5. Information for guidance only

5.1 Solid or stranded. Stranded wire should be used for conductors and cables which are normally flexed in use and servicing of the equipment, such as cables attached to the movable half of detachable connectors and hanging cables attached to removable or movable doors and shields. Leads 150 mm or less in length may be run as solid wires unless they form interconnections between shock isolation mounted parts and nonshock isolation mounted parts. There are some other instances, such as wire wrapping, where a solid conductor may be required regardless of length.

5.2 Cold flow. Certain insulating materials exhibit a cold flow characteristic. Caution should be used in the selection of these materials in applications requiring restrictive clamping or tying, etc, where this feature may result in exposed or shorted conductors.

REQUIREMENT 23

ADHESIVES

1. Purpose. This requirement establishes guidance for the selection and application of adhesives.

2. Documents applicable to Requirement 23:

MMM-A-121	Adhesive, Bonding, Vulcanized Synthetic Rubber to Steel
MMM-A-130	Adhesive, Contact
MMM-A-132	Adhesive, Heat Resistant, Airframe Structural, Metal to Metal
MMM-A-134	Adhesive, Epoxy Resin, Metal to Metal Structural Bonding
MMM-A-138	Adhesive, Metal to Wood, Structural
MMM-A-181	Adhesive, Phenol, Resorcinol, or Melamine Base
MMM-A-189	Adhesive, Synthetic-Rubber, Thermoplastic, General Purpose
MMM-A-1617	Adhesive, Rubber Base, General Purpose
MIL-A-3920	Adhesive, Optical, Thermosetting
MIL-A-5540	Adhesive, Polychloroprene
MIL-A-8576	Adhesive, Acrylic Base, for Acrylic Plastic
MIL-A-22397	Adhesive, Phenol and Resorcinol Resin Base (for Marine Service Use)
MIL-A-24179	Adhesive, Flexible Unicellular-Plastic Thermal Insulation
MIL-A-25463	Adhesive, Film Form, Metallic Structural Sandwich Construction
MIL-A-46050	Adhesive, Cyanoacrylate, Rapid Room-Temperature Curing, Solventless
MIL-A-46146	Adhesive-Sealants, Silicone, RTV, Non-Corrosive (for Use With Sensitive Metals and Equipment)
MIL-A-48611	Adhesive System, Epoxy-Elastomeric, for Glass-To-Metal
MIL-A-52194	Adhesive, Epoxy (for Bonding Glass Reinforced Polyester)
MIL-A-81236	Adhesive, Epoxy Resin With Polyamide Curing Agent
MIL-A-81253	Adhesive, Modified Epoxy Resin With Polyamide Curing Agent
MIL-A-83377	Adhesive Bonding (Structural) for Aerospace and Other Systems, Requirements for
MIL-HDBK-691	Adhesive Bonding
ASTM Standard	Wood; Adhesives - Part 22
ASTM D2564-84	Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings, Specification for
29 CFR 1910	

3. Definitions

3.1 Adhesives. Adhesives are substances capable of holding materials together by surface attachment. Adhesive is a general term and includes, among others, cement, glue, mucilage and paste. All of these terms are loosely used interchangeably.

4. Requirements. Not applicable.

5. Information for guidance only

5.1 Design of joint. The joint should be designed to minimize concentrations of stress. The basic stress should be in shear. The weakest design is where the basic stress is in cleavage or peel and non-axial loading in tension produces cleavage.

5.2 Deleterious effects. The user should ascertain that the formulation of the adhesive selected will have no deleterious effects on the bonded assembly or nearby items when the bonded assembly is in storage, transit or use under the environmental conditions for which it was designed. Deleterious effects may be caused by the slow release of trapped solvents which can damage many types of rubber and plastic, or cause other harmful results degrading operation of the equipment.

5.3 Application. Care should be taken to avoid starved joints which are the result of either absorption of adhesive by a porous material, poor application, inadequate coverage, or excessive pressure. Where one or both of the adherends are porous, successive thin coats of adhesive should be applied to completely seal the surface, and each coat should be dry before the next coat is applied. This procedure should be used instead of the application of one thick adhesive coat to the porous surface, except in the case of silicone adhesives. In general, the thicker the adhesive layer, the lower the shear resistance, but the higher the strength to impact and peeling.

5.4 Structural compatibility. Adhesives which are not compatible structurally should be avoided. For example, a brittle adhesive should not be used for glass bonding because excessive shrinkage during setting or curing will load the glass in tension. For assemblies which may be flexed or subject to impact, a brittle adhesive should not be used.

5.5 Carcinogens. Certain chemicals have been identified in the Occupational Safety and Health Act (OSHA) as cancer producing substances (carcinogens). Before using any materials which might contain carcinogens, they should be evaluated in accordance with the Code of Federal Regulations, Title 29, Chapter XVII, Part 1910. Consideration of the toxicity of a substance should be given prior to material selection.

5.6 Thermoplastic. All thermoplastic adhesives have a tendency to creep under load, especially at elevated temperature, and should not be used in critical structural applications. Many thermoplastic adhesives have limited or poor resistance to certain solvents.

5.7 Materials to be bonded. The materials to be bonded assume critical importance as there are some materials, such as fluorocarbon, polyethylene, and nylon that cannot be bonded satisfactorily without prior treatment, special adhesives, or both.

5.8 Guide for selection and application. The following, although not a complete list, may be used as a guide in selecting adhesives and bonding procedures to meet design requirements in electronic equipment:

MMM-A-121	MMM-A-181	MIL-A-8576	MIL-A-46146	MIL-A-83377
MMM-A-130	MMM-A-189	MIL-A-22397	MIL-A-48611	MIL-HDBK-691
MMM-A-132	MMM-A-1617	MIL-A-24179	MIL-A-52194	ASTM STD-Part 22
MMM-A-134	MIL-A-3920	MIL-A-25463	MIL-A-81236	ASTM D2564
MMM-A-138	MIL-A-5540	MIL-A-46050	MIL-A-81253	

Many of these specifications have no requirements pertaining to electrical properties. Where electrical properties are important, the suitability of the material for the application should be established.

REQUIREMENT 26

ARC-RESISTANT MATERIALS

1. Purpose. This requirement establishes criteria for the selection and application of arc-resistant materials used for insulation of electrical power circuits.

2. Documents applicable to Requirement 26:

L-P-516	Plastic Sheet and Plastic Rod, Thermosetting, Cast
ZZ-R-765	Rubber, Silicone
MIL-I-10	Insulating Compound, Electrical, Ceramic, Class L
MIL-M-14	Molding Plastics and Molded Plastic Parts, Thermosetting
MIL-P-79	Plastic Rod and Tube, Thermosetting, Laminated
MIL-P-997	Plastic Material, Laminated, Thermosetting, Electrical Insulation, Sheets, Glass Cloth, Silicone Resin
MIL-P-15037	Plastic Sheet, Laminated, Thermosetting, Glass-Cloth, Melamine-Resin
MIL-P-19161	Plastic Sheet, Laminated, Glass Cloth, Polytetra-fluoroethylene Resin
MIL-M-24325	Molding Material, Plastic, Epoxy Compounds, Thermosetting
MIL-P-25518	Plastic Material, Silicone Resin, Glass Fiber Base, Low-Pressure Laminated
MIL-P-46112	Plastic Sheet and Strip, Polyimide
FED-STD-406	Plastics: Methods of Testing
ASTM D495-73	Standard Method of Test for High-Voltage, Low-Current Dry Arc Resistance of Solid Electrical Insulation Materials
29 CFR 1910	

3. Definitions. Not applicable.

4. Requirements. Materials shall conform to table 26-I. The materials listed have passed the minimum requirements of 115 seconds when subjected to the arc-resistance test of ASTM D495 or Method 4011 of FED-STD-406, and are listed in approximate order of arc resistance.

5. Information for guidance only

5.1 Applications. Materials may be masked, if necessary, during any treatment of the equipment in which they are used which might result in degradation of the arc-resistant properties of the material. For parts which may be exposed to other than high-voltage, low-current arcing, the materials should be evaluated for overall thermal and electrical characteristics. Suitability for the specific application and the potential for satisfactory performance in elevated humidity, as defined in the detail equipment specification, should also be considered.

5.2 Carcinogens. Certain chemicals have been identified in the Occupational Safety and Health Act (OSHA) as cancer-producing substances (carcinogens). Before using any materials which might contain these chemicals, they should be evaluated in accordance with the Code of Federal Regulations, Title 29, Chapter XVII, Part 1910. Consideration of the toxicity of a substance should be given prior to material selection.

TABLE 26-I. Arc-resistant materials.

Materials	Specification	Types
Ceramic	MIL-I-10	All
Plastic(s), thermosetting, Molding	MIL-M-14	CMI-5, GDI-30, GDI-30F, MAG, MAI-30, MAI-60, MAI-100, MAT-30, MDG, MME, MMI-5, MMI-30, MSG MSI-30, SDG, SDG-F, SDI-30
Molding, epoxy compounds	MIL-M-24325	MEE
Laminated rods and tubes	MIL-P-79	GMG
Laminated sheets		
Glass cloth, melamine resin	MIL-P-15037	GME
Glass cloth, polytetra-fluoroethylene resin	MIL-P-19161	GTE
Glass cloth, silicone resin	MIL-P-997	GSG
Low pressure laminate, silicone resin, glass fiber base	MIL-P-25518	All
Sheet and rod, cast	L-P-516	E-2
Sheet and strip, polyimide	MIL-P-46112	All
Silicone rubber	ZZ-R-765	All

REQUIREMENT 30

SEMICONDUCTOR DEVICES

1. Purpose. This requirement establishes criteria for the selection and application of semiconductor devices.

2. Documents applicable to Requirement 30:

MIL-S-19500	Semiconductor Devices, General Specification for
MIL-STD-701	Lists of Standard Semiconductor Devices
MIL-STD-1547	Parts, Materials, and Processes for Space and Launch Vehicles, Technical Requirements for

3. Definitions. Not applicable.

4. Requirements

4.1 Selection and application. Semiconductor devices shall be selected and applied in accordance with MIL-STD-701, and, for Space Division, AFSC (SD), MIL-STD-1547.

4.1.1 JANS level. JANS level devices shall be used in space, launch, and reentry equipment applications for Space Division, AFSC (SD). When JANS parts are not available, parts shall be specified/procured in accordance with the requirements of MIL-STD-1547.

4.1.2 JANTX and JANTXV levels. JANTX, JANTXV, or JANS level devices shall be used in Army Missile Command, Army Laboratory Command, Naval Air Systems Command and Air Force applications other than SD space, launch, and reentry equipment.

* 4.1.3 JAN level. When JANTX, JANTXV, or JANS level devices are not available, JAN level may be used, subject to procuring activity approval. The JAN parts shall be screened per JANTX requirements of table II of MIL-S-19500. The JAN product shall also be tested in accordance with JAN requirements of table III (Group A) and table IV (Group B) of MIL-S-19500.

4.1.4 Other semiconductors. When MIL-S-19500 devices are not available, other semiconductors may be used, subject to procuring activity approval. All devices shall be screened and tested as in 4.1.3 above.

4.2 Sealing. All semiconductor devices used in equipment shall be hermetically sealed in glass, metal, metal oxide, ceramic, or combination of these. Use of plastic (organic or polymeric) encapsulated or sealed devices requires the approval of the procuring activity.

5. Information for guidance only. Semiconductor devices are susceptible to electrostatic discharge damage. Appropriate discharge procedures should be observed prior to handling these parts, and design selections of desired devices should include a consideration of the effectiveness of the input or other protective elements included in the device design.

REQUIREMENT 41

SPRINGS

1. Purpose. This requirement establishes criteria for the design, selection, and application of springs.

* 2. Documents applicable to Requirement 41:

QQ-B-750	Bronze, Phosphor, Bar, Plate, Rod, Sheet, Strip, Flat Wire and Structural and Special Shaped Sections
QQ-C-530	Copper-Beryllium Alloy, Bar, Rod, and Wire (Copper Alloy Numbers 172 and 173)
QQ-C-533	Copper-Beryllium Alloy Strip (Copper Alloy Numbers 170 and 172)
QQ-C-585	Copper-Nickel-Zinc Alloy Plate, Sheet, Strip and Bar (Copper Alloy Numbers 735, 745, 752, 762, 766, and 770)
QQ-C-586	Copper-Nickel-Zinc Alloy; Rod, Shapes, Flat Products with Finished Edges (Flat Wire, Strip, and Bar)
QQ-S-766	Steel, Stainless and Heat Resisting, Alloys, Plate, Sheet, and Strip
QQ-W-321	Wire, Copper Alloy
MIL-S-7947	Steel, Sheet and Strip (1095) Aircraft Quality
MIL-S-13282	Silver and Silver Alloy
MIL-S-13572	Spring, Helical, Compression and Extension
MIL-C-19311	Copper-Chromium Alloy Forgings, Wrought Rod, Bar and Strip (Copper Alloy Numbers 182, 184 and 185)
MIL-S-22215	Silver-Copper-Cadmium-Nickel Alloy
MIL-S-46049	Strip, Metal, Carbon Steel, Cold Rolled, Hardened and Tempered, Spring Quality
MIL-C-81021	Copper-Beryllium Alloy (Copper Alloy Numbers C17500 and C17510), Strip
ASTM A29/A29M-88	Steel Bars, Carbon and Alloy, Hot Wrought and Cold Finished, General Requirements for
ASTM A228/A228M-83	Steel Wire, Music Spring Quality
ASTM A313-87	Chromium-Nickel Stainless and Heat Resisting Steel Spring Wire
ASTM A682-79	Steel, Strip, High Carbon, Cold Rolled, Spring Quality, General Requirements for
ASTM A684/A684M-86	Steel, Strip, High Carbon, Cold Rolled
ASTM B522-80	Gold-Silver-Platinum Electrical Contact Alloy, Specification for

Metals Handbook, Vol I (1978), American Society for Metals

3. Definitions. Not applicable.

4. Requirements

4.1 Helical springs. Helical springs shall conform to MIL-S-13572.

4.2 Electrical contact springs. Electrical contact springs shall use materials selected from table 41-I.

4.3 Carbon steel springs. Carbon steel springs shall be suitably plated or finished to resist corrosion.

5. Information for guidance only

5.1 Corrosion resisting steel. Corrosion resisting steel springs are preferred where electrical conductivity is not a consideration and where they are adequate for the purpose intended.

5.2 Fatigue limits. Fatigue limits of the springs should not be adversely affected by corrosion, operating temperature, and other environmental conditions in service. Fatigue limits should be consistent with the maximum specified operating cycles for the respective part or equipment or, if such is not specified, with the maximum duty cycle to be expected during the equipment service life.

5.3 Electrical conductivity. Electrical conductivity of contact springs should not be adversely affected by corrosion, operating temperature and other environmental conditions in service.

5.4 Enclosure. Where practicable, springs should be enclosed in housings or otherwise captivated in order to prevent broken pieces from entering and adversely affecting the equipment.

5.5 Heat treatment. Springs made of materials that achieve their desired properties by heat treatment, such as copper-beryllium alloys, annealed carbon steels, CRES steels, or heat resisting alloys, should be heat treated to the specified temper after forming.

5.6 Grain orientation. Flexure and forming of springs should be designed to occur perpendicular to the grain of the material. Deviation from the perpendicular should not exceed 45 degrees.

5.7 Documents for specifying materials. When the materials listed in tables 41-I, 41-II, and 41-III are used, they should conform to the specifications listed for each material.

TABLE 41-I. Materials for electrical spring application.

Material	Form	Material specification
Copper-nickel-zinc alloy	Plate, sheet, strip and rolled bar	QQ-C-585
Copper-nickel-zinc alloy	Rod, shapes and flat products with finished edges (flat wire, strip and bar)	QQ-C-586
Copper-beryllium alloy	Bars, rods, and wire	QQ-C-530
Copper-beryllium alloy	Strip	QQ-C-533
Copper alloy	Wire, spring	QQ-W-321
Copper-cobalt-beryllium alloy	Strip	MIL-C-81021
Copper-chromium alloy	Bar, rod, and strip	MIL-C-19311
Phosphor bronze	Bar, rod, plate, sheet, strip, and flat wire	QQ-B-750
Platinum-iridium alloy	Strip	ASTM B522
Silver-copper alloy	Bar, rod, plate, sheet, strip, and wire	MIL-S-13282
Silver-copper-cadmium-nickel-alloy	Rod, sheet, strip, and wire	MIL-S-22215
Palladium-copper alloy		Metals Handbook, Vol I

* TABLE 41-II. Corrosion resisting steel for springs.

Material	Form	Material specification
Steel, CRES	Wire Strip	ASTM A313 QQ-S-766

* TABLE 41-III. Carbon steel for springs.

Material	Form	Material specification
Steel, high carbon	Wire, spring, music	ASTM A228
Steel, carbon and alloy (for springs)	Strip, cold rolled untempered spring	ASTM A682 ASTM A684
Steel, carbon and alloy (for springs)	Bars, round, square and flat	ASTM A29
Steel, carbon, strip	Cold rolled, hardened and tempered spring	MIL-S-46049
Steel, carbon (1095)	Sheet and strip A-annealed (condition 1) H-hard temper (condition 3) cold finished	MIL-S-7947

REQUIREMENT 42

TUNING DIAL MECHANISMS

1. Purpose. This requirement establishes criteria for the design of tuning dial mechanisms.

2. Documents applicable to Requirement 42:

MIL-S-3644	Shaft Assembly, Flexible
MS33558	Numerals and Letters, Aircraft Instrument Dial, Standard Form of

3. Definitions. Not applicable.

4. Requirements

4.1 Dial. The division marking and lettering on tuning dials shall be suitably etched or printed with characters of style MS33558. Dial markings shall be legible at a distance of 0.6 meter from any point within a solid angle of 60 degrees defined by a surface of revolution about a line through the center of the dial and perpendicular to the panel. Minimum space between characters shall be one stroke width. The width of the lubber line or pointer tip shall not exceed the width of the graduation marks. Except for digital tuning indicators, for which only one calibration number will be seen, dials shall be marked so that at least two calibration numbers on each band can be seen at any dial setting.

4.2 Balance and friction. Weighted tuning knobs shall be counterbalanced. Friction in tuning dial mechanism shall allow smooth and easy adjustment of the operating knob over the entire operating range of the mechanism, but shall have sufficient resistance or shall incorporate a positive locking device to maintain the setting under all specified service conditions. Friction shall be achieved through dry or elastic resistance rather than by fluid resistance.

4.3 Flexible control shafts. Flexible shaft assemblies conforming to MIL-S-3644 shall be used when a flexible mechanical connection is required between the tuning knob and the tuned device.

5. Information for guidance only

5.1 Tuning ratio. The tuning ratio used should be the optimum which will permit both rapid and precise setting.

REQUIREMENT 43

LUBRICANTS

1. Purposes. This requirement establishes criteria for the selection and application of lubricants.

2. Documents applicable to Requirement 43:

VV-L-800	Lubricating Oil, General Purpose, Preservative (Water-Displacing, Low-Temperature)
VV-P-236	Petrolatum, Technical
MIL-L-2105	Lubricating Oil, Gear, Multi-Purpose
MIL-L-3150	Lubricating Oil, Preservative, Medium
MIL-L-3918	Lubricating Oil, Instrument, Jewel Bearing
MIL-L-6085	Lubricating Oil, Instrument, Aircraft, Low Volatility
MIL-L-6086	Lubricating Oil, Gear, Petroleum Base
MIL-L-15719	Lubricating Grease (High-Temperature, Electric Motor, Ball and Roller Bearings)
MIL-L-17331	Lubricating Oil, Steam Turbine (Noncorrosive)
MIL-L-17672	Lubricating Oil, Hydraulic and Light Turbine, Noncorrosive
MIL-G-23827	Grease, Aircraft and Instrument, Gear and Actuator Screw
MIL-G-24139	Grease, Multi-Purpose, Quiet Service
DOD-G-24508	Grease, High Performance, Multi-Purpose (Metric)
MIL-G-81322	Grease, Aircraft, General Purpose, Wide Temperature Range
29 CFR 1910	

3. Definitions. Not applicable.

4. Requirements

4.1 General. Lubricants shall conform to one of the following:

VV-L-800	MIL-L-6085	MIL-G-23827
VV-P-236	MIL-L-6086	MIL-G-24139
MIL-L-2105	MIL-L-15719	DOD-G-24508
MIL-L-3150	MIL-L-17331	MIL-G-81322
MIL-L-3918	MIL-L-17672	

4.2 Silicones. Silicone compounds shall not be used as lubricants.

4.3 Graphite base lubricants. Graphite base lubricants shall not be used.

5. Information for guidance only

5.1 Variety. The number of different lubricants should be held to a minimum.

5.2 Volatility. Low volatility lubricants should be used where practical.

5.3 Compatibility. The lubricant should be chemically inert with regard to the materials it contacts.

5.4 Carcinogens. Certain chemicals have been identified in the Occupational Safety and Health Act (OSHA) as cancer-producing substances (carcinogens). Before using any materials which might contain these chemicals, they should be evaluated in accordance with the Code of Federal Regulations, Title 29, Chapter XVII, Part 1910. Consideration of the toxicity of a substance should be given prior to material selection.

REQUIREMENT 44

FIBROUS MATERIALS, ORGANIC

1. Purpose. This requirement establishes criteria for the selection and application of organic fibrous materials.

2. Documents applicable to Requirement 44:

V-T-276	Thread, Cotton
V-T-285	Thread, Polyester
V-T-291	Thread, Linen
V-T-295	Thread, Nylon
CCC-C-428	Cloth, Duck, Cotton; Fire, Water, Weather, and Mildew Resistant
MIL-W-530	Webbing, Textile, Cotton, General Purpose, Natural or in Colors
MIL-C-572	Cords, Yarns, and Monofilaments, Organic Synthetic Fiber
MIL-T-3530	Thread and Twine, Mildew Resistant or Water Repellant Treated
MIL-W-4088	Webbings, Textile, Woven Nylon
MIL-C-9074	Cloth, Laminated, Sateen, Rubberized
MIL-W-27265	Webbing, Textile, Woven Nylon, Impregnated
29 CFR 1910	

3. Definitions. Not applicable.

4. Requirements

4.1 Webbing

4.1.1 Cotton. Cotton webbing shall conform to MIL-W-530, class 4 or 7. Class 7 shall be used when webbing will come in contract with natural or synthetic rubber or class 4 when prolonged contact with the skin may occur.

4.1.2 Nylon. Nylon webbing shall conform to MIL-W-4088 or class R of MIL-W-27265.

4.2 Cotton duck. Cotton duck used for protective enclosures shall conform to type I or type II of CCC-C-428. Medium texture number 4 shall be used for heavy duty service and hard texture number 12 shall be used for services requiring light weight.

4.3 Thread. Thread shall conform to V-T-276, V-T-285, V-T-291, or V-T-295.

4.3.1 Treatment. Cotton and linen thread shall be treated in accordance with MIL-T-3530. Type I, class 2 mildew inhibiting agent shall be used when thread will come in contact with natural or synthetic rubber or type I, class 1 when prolong contact with the skin may occur.

4.4 Sateen. Laminated, two-ply rubberized cotton sateen shall conform to MIL-C-9074. This sateen shall not be used when prolonged contact with the skin may occur.

4.5 Cords, yarn, and monofilaments. Cords, yarns, and monofilaments shall conform to MIL-C-572. Types PVCA, AR, VCR, and CTA shall not be used where they may be exposed to fungus attack.

5. Information for guidance only

5.1 Shrinkage. Fabric and thread should be preshrunk or allowance should be made for shrinkage in order to provide for satisfactory fit of finished items both before and after they are immersed in water and then dried.

5.2 Carcinogens. Certain chemicals have been identified in the Occupational Safety and Health Act (OSHA) as cancer producing substances (carcinogens). Before using any materials which might contain these chemicals, they should be evaluated in accordance with the Code of Federal Regulations, Title 29, Chapter XVII, Part 1910. Consideration of the toxicity of a sub- stance should be given prior to material selection.

REQUIREMENT 46

MOTORS AND ROTARY POWER CONVERTERS

1. Purpose. This requirement establishes criteria for the selection and application of motors and rotary power converters.

2. Documents applicable to Requirement 46:

MIL-D-24	Dynamotors, General Specification for
MIL-G-3111	Generator, Electric, Direct Current (Naval Shipboard Use)
MIL-G-3124	Generator, Alternating Current, 60 Cycle (Naval Shipboard Use)
MIL-M-4820	Motor-Generator, Skid Mounted, Type MD-4
MIL-M-7969	Motor, Alternating Current, 400 Cycle, 115/200-Volt System, Aircraft, General Specification for
MIL-M-8609	Motors, Direct Current, 28 Volt System, Aircraft, General Specification for
MIL-F-9397	Frequency Converter, Mobile, Type MC-1A
MIL-M-13786	Motors, Fractional Horsepower, Direct Current and Universal (for Communication and Other Electronic and Special Military Applications)
MIL-M-13787	Motors, Alternating Current, Fractional Horsepower, Squirrel Cage (for Communication and Other Electronic and Special Military Applications)
MIL-M-17059	Motor, 60 Cycle, Alternating Current, Fractional Horsepower (Shipboard Use)
MIL-M-17060	Motors, 60 Hertz, Alternating Current, Integral Horsepower (Shipboard Use)
MIL-M-17413	Motors, Direct Current, Integral Horsepower, Naval Shipboard
MIL-M-17556	Motor, Direct Current, Fractional Horsepower, (Shipboard Use)
MIL-M-19097	Motor-Generators, DC to AC, Shipboard Service
MIL-M-19160	Motor-Generator, 60 Hertz AC to 400 Hertz AC, Shipboard Service
MIL-M-19167	Motor-Generator, AC to DC, Shipboard Service
MIL-M-19283	Motor-Generator, DC to DC, Shipboard Service
MIL-M-19633	Motor-Generator, 60 Cycle AC to 400 Cycle AC (Voltage and Frequency Regulated) Shipboard Service
MIL-B-23071	Blowers, Miniature, for Cooling Electronic Equipment, General Specification for

3. Definitions. Not applicable.

4. Requirements

4.1 Motors - alternating current. Alternating current motors shall conform to MIL-M-7969, MIL-M-13787, MIL-M-17059 or MIL-M-17060, except that any motor used with a miniature blower for cooling electronic equipment shall be in accordance with MIL-B-23071.

4.2 Motors - direct current. Direct current motors shall conform to MIL-M-8609, MIL-M-13786, MIL-M-17413 or MIL-M-17556.

* 4.3 Motor-generators. Motor-generators shall conform to one of the following:

MIL-M-4820
MIL-M-9397
MIL-M-19097
MIL-M-19160
MIL-M-19167
MIL-M-19283
MIL-M-19633

4.4 Generators - alternating current. Alternating current generators shall conform to MIL-G-3124.

4.5 Generators - direct current. Direct current generators shall conform to MIL-G-3111.

4.6 Dynamotors. Dynamotors shall conform to MIL-D-24.

5. Information for guidance only. Not applicable.

REQUIREMENT 47

ENCAPSULATION AND EMBEDMENT (POTTING)

1. Purpose. This requirement establishes criteria for encapsulating and embedding (potting) a part or an assembly of discrete parts. Conformal coating of printed circuit assemblies is excluded from this requirement.

* 2. Documents applicable to Requirement 47:

MIL-S-8516	Sealing Compound, Polysulfide Rubber, Electric Connectors and Electric Systems, Chemically Cured
MIL-I-16923	Insulating Compound, Electrical, Embedding
MIL-S-23586	Sealing Compound, Electrical, Silicone Rubber, Accelerator Required
MIL-M-24041	Molding and Potting Compound, Chemically Cured, Polyurethane (Polyether Based)
MIL-I-81550	Insulating Compound, Electrical, Embedding, Reversion Resistant Silicone
29 CFR 1910	

3. Definitions

3.1 Encapsulation. A process for encasing a part or an assembly of discrete parts within a protective material which is generally not over 2.5 mm thick and does not require a mold or container.

3.2 Embedment (potting). A process for encasing a part or an assembly of discrete parts within a protective material which is generally over 2.5 mm thick, varies in thickness, fills the connecting areas within an assembly, and requires a mold or container to confine the material while it is hardening. Potting is an embedding process where the protective material bonds to the mold or container so that it becomes integral with the item.

4. Requirements. Encapsulation and embedment materials shall be of a nonreversion type and shall be selected from the following specifications: MIL-S-8516, MIL-I-16923, MIL-S-23586, MIL-M-24041, and MIL-I-81550. The materials selected shall be capable of filling all voids and air spaces in and around the items being encased. For Air Force applications, approval for use of any material other than transparent silicone in accordance with MIL-I-81550 shall be requested through the procuring activity from the Air Force Wright Aeronautical Laboratories, ATTN: MLSE, Wright-Patterson AFB OH 45433-6503.

5. Information for guidance only

5.1 Selection. The following points should be considered when selecting an encapsulation or embedment material:

a. Need for precautions due to hazardous characteristics of the material

b. Electrical, mechanical and thermal properties, including tear resistance, resistance to flame, chemicals, moisture, water, humidity, fungus, and temperature extremes

c. Color or transparency

d. Dissipation factor

e. Specific gravity

f. Shrinkage

g. Heat distortion parameters

h. Stresses on parts

i. Durometer hardness

j. Adhesion to substrates (and priming)

k. Temperatures of application and curing

l. Repairability

m. Dielectric constant

n. Volume resistivity

o. Reversion resistance, including hydrolytic stability

p. Viscosity

q. Solvent affects

r. Compatibility with parts or assemblies to which applied.

5.2 Application. The encapsulation or embedment of microelectronic modules and equipment modules should be avoided, except where specifically indicated by the requirements of a particular application. In such instances, the module design should be completely verified for the particular encapsulation or embedment materials and processes to be employed. Any changes in module design, materials, and processes may require re-evaluation of the modules. In particular, extreme temperature aging and temperature cycling tests should be performed to verify adequacy of the design. Wherever economically feasible, the module to be encapsulated or embedded should be designed as a throw-away unit.

5.3 Carcinogens. Certain chemicals have been identified in the Occupational Safety and Health Act (OSHA) as cancer-producing substances (carcinogens). Before using any materials which might contain these chemicals, they should be evaluated in accordance with the Code of Federal Regulations, Title 29, Chapter XVII, Part 1910. Consideration of the toxicity of a substance should be given prior to material selection.

REQUIREMENT 50

INDICATOR LIGHTS

1. Purpose. This requirement establishes criteria for selection and application of indicator lights and associated items.

2. Documents applicable to Requirement 50:

W-L-00111	Lamp, Incandescent, (Electric, Miniature and Subminiature, Tungsten Filament)
W-L-00116	Lamps, Fluorescent (General Specification)
MIL-L-3661	Lampholders, Indicator Lights, Indicator-Light Housings, and Indicator-Light Lenses, General Specification for
MIL-L-6363	Lamps, Incandescent, Aircraft Service, General Requirements for
MIL-L-7806	Light, Panel, Plastic Plate Lighting
MIL-L-7961	Lights, Indicators, Press to Test
MIL-L-15098	Lamp, Glow, General Specification for
MIL-S-19500	Semiconductor Devices, General Specification for
MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment and Facilities

3. Definitions. Not applicable.

4. Requirements

4.1 Lights and accessories. Indicator lights, indicator light housings, lampholders, lenses, and lamps shall be selected in accordance with table 50-I.

4.2 Visual display and legend lights. Visual display and legend lights shall comply with the requirements in MIL-STD-1472.

4.3 Light emitting diodes (LED's). LED's when used as indicator lights shall conform to the applicable detail specifications of MIL-S-19500.

5. Information for guidance only. Not applicable.

TABLE 50-I. Indicator lights and associated items.

	MIL-L-3661	MIL-L-7806	MIL-L-7961	MIL-L-6363	MIL-L-15098	MIL-S-19500	W-L-00111	W-L-00116
Indicator lights	X		X			X		
Indicator light housings	X							
Lamp holders	X	X						
Lenses	X							
Incandescent lamps, general purpose				X			X	
Incandescent lamps, severe environment				X				
Neon lamps					X			X
Fluorescent lamps								X

REQUIREMENT 52

THERMAL DESIGN

1. Purpose. This requirement establishes criteria for thermal design.

2. Documents applicable to Requirement 52:

F-F-300	Filter, Air Conditioning, Viscous-impingement and Dry Types, Cleanable
MIL-F-16552	Filter, Air Environmental Control System, Cleanable, Impingement (High Velocity Type)
MIL-B-23071	Blowers, Miniature, for Cooling Electronic Equipment, General Specification for
MIL-HDBK-251	Reliability/Design, Thermal Applications

3. Definitions

3.1 Auxiliary heating or cooling. External heating or cooling devices not normally part of the equipment configuration.

3.2 Cold plate. A heat transfer surface cooled by forced air or other heat transfer fluid to which heat dissipating parts are mounted.

3.3 Contaminant. Any foreign substance contained in air or other heat transfer fluid which adversely affects cooling performance, such as dust particles, lint, oil, sludge, etc.

3.4 Direct impingement. Passing cooling air over parts without the use of cold plates or heat exchangers.

3.5 Entrained water. Water condensed from the cooling air and carried along with the cooling air.

3.6 External source supplied cooling air. Forced air supplied from a conditioning source such as an air conditioner or aircraft environmental control system which is not normally a part of the electronic equipment.

3.7 Forced air cooling. The dissipation of heat to cooling air, including ram air, supplied by a source with sufficient pressure to flow through the unit.

3.8 Heat exchanger. An air-to-air or liquid-to-air finned duct arrangement which is used to transfer dissipated heat from a hot recirculating fluid to the cooling fluid by conduction through the finned surfaces.

3.9 Natural cooling. The dissipation of heat to surroundings by conduction, convection, radiation, or any combination thereof without the benefit of external cooling devices.

3.10 Part. An element or component used in the production of an electronic equipment or subsystem, such as a microcircuit, diode, transistor, capacitor, resistor, relay switch, or transformer.

3.11 Pressure drop (differential pressure). Resistance to flow usually measured as the static pressure difference across the electronic equipment from inlet to coolant outlet.

4. Requirements

4.1 Forced air cooling. Forced air cooling shall be used only when natural cooling is not adequate. Exhaust and recirculating fans and blowers shall be driven by ac brushless motors or by properly shielded dc motors. Miniature blowers shall conform to MIL-B-23071. Air filters shall be provided for air intakes for fan and blower cooled units when required to protect internal parts. Filters, when used, shall conform to F-F-300 or MIL-F-16552, and shall be removable for cleaning without disassembly of the equipment. All ventilation openings shall be designed and located to comply with electromagnetic interference, undesired radiation and enclosure requirements. Air exhaust shall be directed away from operating personnel.

4.1.1 External source. For equipment designed for use with external source supplied cooling air, which may contain entrained water or other contaminants detrimental to the equipment, precautionary measures shall be taken to avoid direct impingement on internal parts and circuitry by channeling or use of heat exchangers.

• 4.1.2 Aircraft application. Equipment that is intended for use in aircraft and requires forced air cooling shall be designed using cold plates or heat exchangers so that none of the cooling air will come into contact with internal parts, circuitry, or connectors.

4.2 Other cooling methods. Prior approval of the procuring activity shall be obtained when heat densities or other design requirements make the use of air for cooling impractical and alternate methods, such as liquid, evaporative, change of phase material, or heat pipes, are required.

5. Information for guidance only. The design factors which should be considered in determining the required fan or blower characteristics include such factors as amount of heat to be dissipated, the quantity of air to be delivered at the pressure drop of the enclosed equipment, the allowable noise level, the permissible level of heat that may be exhausted into the surrounding environment, and other pertinent factors affecting the cooling requirement of the equipment. Induced drafts and ventilation by means of baffles and internal vents should be used to the greatest practicable extent. When practicable, ventilation and air exhaust openings should not be located in the top of enclosures or in front panels. When it is impractical to avoid direct impingement on internal parts and circuitry by channeling or use of heat exchangers, the water and contaminants should be removed from the cooling air by suitable water and contaminant removal devices.

5.1 External source. For equipment designed for use with external source supplied cooling air, minimum differential pressure (pressure drop) of the cooling air through the equipment heat exchanger or cold plate should be maintained, consistent with adequate cooling.

5.2 Design guidance. MIL-HDBK-251 may be used as a guide for detail information on thermal design of electronic equipment.

REQUIREMENT 66

CABLE, MULTICONDUCTOR

1. Purpose. This requirement establishes criteria for selection and application of electrical multiconductor cable for use within electronic equipment.

2. Documents applicable to Requirement 66:

QQ-W-343	Wire, Electrical, Copper (Uninsulated)
QQ-W-423	Wire, Steel, Corrosion-Resisting
MIL-C-17	Cables, Radio Frequency, Flexible and Semirigid, General Specification for
MIL-C-442	Cable (Wire), Two Conductor, Parallel
MIL-C-3432	Cable (Power and Special Purpose) and Wire, Electrical (300 and 600 Volts)
MIL-W-5086	Wire, Electric, Polyvinyl Chloride Insulated, Copper or Copper Alloy
MIL-W-5845	Wire, Electrical, Iron and Constantan, Thermocouple
MIL-W-5846	Wire, Electrical, Chromel and/or Alumel, Thermocouple
MIL-W-5908	Wire, Electrical, Copper and Constantan, Thermocouple
MIL-C-7078	Cable, Electric, Aerospace Vehicle, General Specification for
MIL-W-8777	Wire, Electrical, Silicone-Insulated, Copper, 600 Volt, 200°C
MIL-C-13777	Cable, Special Purpose, Electrical: General Specification for
MIL-W-16878	Wire, Electrical, Insulated, General Specification for
MIL-C-19547	Cable, Electrical, Special Purpose, Shore Use
MIL-C-21609	Cable, Electrical, Shielded, 600 Volt (for Nonflexing Service)
MIL-W-22759	Wire, Electric, Fluoropolymer-Insulated, Copper or Copper Alloy
MIL-C-23437	Cable, Electrical, Shielded Pairs
MIL-C-24640	Cable, Electrical, Lightweight, for Shipboard Use, General Specification for
MIL-C-24643	Cable and Cord, Electrical, Low Smoke, for Shipboard Use, General Specification for
MIL-W-25038	Wire, Electrical, High Temperature and Fire Resistant, Aircraft
MIL-C-27072	Cable, Special Purpose, Electrical, Multiconductor
MIL-C-27500	Cable, Electrical, Shielded and Unshielded, Aerospace
MIL-C-55021	Cable, Twisted Pairs and Triples, Internal Hookup, General Specification for
MIL-W-81044	Wire, Electric, Crosslinked Polyalkene, Crosslinked Alkane-imide Polymer, or Polyarylene Insulated, Copper or Copper Alloy
MIL-W-81381	Wire, Electric, Polyimide-Insulated, Copper or Copper Alloy
ASTM B33-74	Tinned Soft or Annealed Copper Wire for Electrical Purposes

3. Definitions. Not applicable.

4. Requirements

4.1 Selection and application. Selection and application of multiconductor cable shall be in accordance with table 66-I.

4.2 Solid or stranded. Either solid or stranded conductors may be used (within the restrictions of the particular wire or cable specification) except that (a) with the exception of thermocouple and flat cable wire, only stranded wire shall be used in aerospace applications, and (b) for other applications stranded wire shall be used when so indicated by the equipment application. Specifically, with the exception of flat multiconductor flexible cable, stranded wire shall be used for wires and cables which are normally flexed in use and servicing of the equipment, such as cables attached to the movable half of detachable connectors.

4.3 Application restrictions

4.3.1 MIL-W-16878 shall not be used for Air Force aerospace equipment.

* 4.3.2 Cables with polyvinyl chloride insulation shall not be used in aerospace applications. Use of these cables in any other Air Force or Army Missile Command application requires prior approval of the procuring activity.

4.3.3 MIL-W-22759 wire with only single polytetrafluoroethylene insulation used in Air Force space and missile applications shall require the approval of the procuring activity.

* 4.34 Silver plated copper wire shall not be used in applications involving Army missile systems.

5. Information for guidance only. Not applicable.

TABLE 66-I. Cable, multiconductor.

Spec No.	Title	Basic Wire Specs	Conductor			Shield Braid 3/			Jacket 3/		Remarks
			No. of Cond	Volts RMS	Temp 2/	Strand Material	Strand Coating	% Coverage	Material 1/	Type	
MIL-C-442	Cable, (Wire), Two Conductor, Parallel	QQ-W-343 & Insulation	2	300	Flexibility at -40°C or -55°C				Vinyl-polymer or synthetic (styrene butadiene) rubber or natural rubber		Lead wire for firing explosive charges
MIL-C-3432	Cable (Power and Special Purpose) and Wire, Electrical (300 & 600V)	QQ-W-343 & Insulation	Unlimited and mixed sizes 4/ 5/	300 & 600	-40°C to +65°C or -55°C to +75°C	None or Copper	Tin	85	Styrene butadiene or chloroprene rubber	Extruded & vulcanized	
MIL-C-7078	Cable, Electric, Aerospace Vehicle	M5086/1 M5086/2 M5086/3	2-7 1-7 1-7	600	105°C	Copper Copper	Tin Tin		None Polyamide (Nylon)	Extruded or ImpregBraid	(a) Fluorinated ethylene propylene (b) Polytetrafluoroethylene
		M22759/12 M22759/23	1-7 1-7		260°C 260°C	Copper Copper	Nickel Nickel	85 85	(a) (b)	Extruded Extruded or tape	
		M81044/9	1-7		110°C	Copper	Tin	85	Polyvinylidene fluoride	Extruded	
		M81381/8 /10 and /14	2-7 1-7		200°C 200°C	Copper	Nickel	85	FEP/polyimide	Film Tape	
		M81381/11 M81381/12 M81381/13	2-7 1-7 1-7		200°C 150°C 200°C	Copper Copper	Tin Nickel	85 85	FEP/polyimide	Film Tape	
MIL-C-13777	Cable, Special Purpose, Electrical	MIL-C-17 QQ-W-343 QQ-W-423 & Insulation	2-78 6/	600	-53°C to +71°C	Copper	Tin	80	Sheath Polychloroprene Primary Insulation Polyethylene	Extruded & vulcanized Extruded	See Note 7
MIL-C-19547	Cable, Electrical, Special purpose, Shore Use	ASTM B33-74 & Insulation	Multiple twisted pairs, 6-100 pairs	600	75°C	Corrugated Aluminun		100	Polyethylene	Extruded	For use as telephone & telegraph signal cables in shore communications
MIL-C-21609	Cable, Electrical, Shielded 600V (for Non-flex Service)	MIL-C-17 MIL-W-5086 MIL-C-24640	2-61	600	105°C	Electrolytic tough pitch copper tape	Annealed tape tinned	Not specified	Black polyamide over black PVC		

TABLE 66-I. Cable, multiconductor. - Continued

Spec No.	Title	Basic Wire Specs	Conductor: No. of Cond	Conductor: Volts RMS	Conductor: Temp 2/	Shield Braid 3/: Strand Material	Shield Braid 3/: Strand Coating	Shield Braid 3/: % Coverage	Jacket 3/: Material 1/	Jacket 3/: Type	Remarks
MIL-C-23437	Cable, Electrical, Shielded Pairs	MIL-W-16878/1	Shielded & jacketed twisted pairs 1 pair-104 pairs	600	105°	Copper	Tin	90	PVC	Extruded	For use within shore communications stations, not to be used on board ship
						Note: Shield applied over each pair					
MIL-C-27072	Cable Special Purpose, Electrical, Multiconductor	MIL-C-17	2-36	Various	Not Spec	Copper	Tin, Silver	85	Sheath of PVC, polyethylene, polychloroprene, polyamide, TFE-Teflon, or FEP-Teflon		Flexible multiconductor cable for use in protected areas: tunnels, wire ways, instrument racks, and conduit. Polyethylene jacketed cable suitable for underwater or direct burial applications only. M16878/6 and /13 not for aerospace applications.
		MIL-W-5845		Various	Not spec						
		MIL-W-5846		Various	Not spec						
		MIL-W-5908		Various	Not spec						
		M16878/1		600	105°C						
		M16878/2		1000	105°C						
		M16878/3		3000	105°C						
		M16878/4		600	200°C						
		M16878/5		1000	200°C						
		M16878/6		250	200°C						
		M16878/10		600	75°C						
		M16878/13		250	200°C						
						Note: MIL-C-27072 applicable detail specification sheets control materials for each specific cable configuration.					
MIL-C-27500	Cable, Electrical, Shielded and Unshielded, Aerospace	MIL-W-8777	1-7	600	200°C	Various	Various	85	Various	Braided	For general aerospace flight vehicle applications
		MIL-W-22759	1-7	Various	Various	Various	Various	85	Various	Extruded or Braided	
		MIL-W-25038	1-7	600	260°C	Various	Various	85	TFE coated glass fiber	Braided	
		MIL-W-81044	1-7	600	150°C	Various	Various	85	Various	Extruded	
		MIL-W-81381	1-7	600	Various	Various	Various	85	Various	Tape	
MIL-C-55021	Cable, Twisted Pairs & Triples, Internal Hookup, General Specification for	MIL-W-16878	2-3	600 to 1000	-40°C to +80°C or -65°C to +200°C	None or Copper	Tin, Silver or Nickel	90	None PVC, Nylon TFE-Teflon	Extruded Extruded or Tape	

TABLE 66-I. Cable, multiconductor. - Continued

NOTES:

1/ Polyester - Polyethylene Terephthalate
TFE-Teflon - Polytetrafluoroethylene
PVC - Polyvinyl chloride (Not to be used in airborne applications)
KEL-F - Polymonochlorotrifluoroethylene
FEP-Teflon - Fluorinated ethylene propylene
PVF - Polyvinylidene fluoride

2/ See applicable detail specification sheet for temperature limitation.

3/ See applicable detail specification sheet for materials control of specific cable configurations

4/ Although the specification does not limit the number of conductors in a cable, the size, weight, and flexibility are determining factors.

5/ Available in three classifications:

Class L - Light Duty - to withstand severe flexing and frequent manipulation

Class M - Medium Duty - to withstand severe flexing and mechanical abuse

Class H - Heavy Duty - to withstand severe flexing and mechanical abuse and ability to withstand severe service impacts such as to be run over by tanks or trucks

6/ See applicable detail specification sheet for mechanical test requirements for cold bend, cold bend torque, impact bend, and twist.

7/ For use under abusive mechanical conditions and where resistance to weather, oil and ozone are requirements.

REQUIREMENT 71

CABLE AND WIRE, INTERCONNECTION

1. Purpose. This requirement establishes criteria for the selection and application of electric cable and wire used for interconnection between units.

2. Documents applicable to Requirement 71:

QQ-W-343	Wire, Electrical, Copper (Uninsulated)
QQ-W-423	Wire, Steel, Corrosion-Resisting
MIL-C-17	Cables, Radio Frequency, Flexible and Semi-rigid, General Specification for
MIL-W-76	Wire and Cable, Hookup, Electrical, Insulated
MIL-C-442	Cable, Two Conductor, Parallel
MIL-C-3432	Cable (Power and Special Purpose) and Wire, Electrical (300 and 600 Volts)
MIL-W-5086	Wire, Electric, Polyvinyl Chloride Insulated, Copper or Copper Alloy
MIL-W-5845	Wire, Electrical, Iron and Constantan, Thermocouple
MIL-W-5846	Wire, Electrical, Chromel and Alumel, Thermocouple
MIL-W-5908	Wire, Electrical, Copper and Constantan, Thermocouple
MIL-C-7078	Cable, Electric, Aerospace Vehicle, General Specification for
MIL-W-8777	Wire, Electrical, Silicone-Insulated, Copper, 600 Volt, 200°C
MIL-C-13777	Cable, Special Purpose, Electrical: General Specification for
MIL-W-16878	Wire, Electrical, Insulated, General Specification for
MIL-W-19150	Wire, Insulated, Hard Drawn Copper
MIL-C-19547	Cable, Electrical, Special Purpose, Shore Use
MIL-C-21609	Cable, Electrical, Shielded, 600 Volt (for Nonflexing Service)
MIL-C-22759	Wire, Electric, Fluoropolymer-Insulated, Copper or Copper Alloy
MIL-C-23437	Cable, Electrical, Shielded Pairs
MIL-C-24640	Cable, Electrical, Lightweight, for Shipboard Use, General Specification for
MIL-C-24643	Cable and Cord, Electrical, Low Smoke, for Shipboard Use, General Specification for
MIL-W-25038	Wire, Electrical, High Temperature and Fire Resistant, General Specification for
MIL-C-27072	Cable, Special Purpose, Electrical, Multiconductor
MIL-C-27500	Cable, Electrical, Shielded and Unshielded, Aerospace
MIL-C-55021	Cables, Twisted Pairs and Triples, Internal Hookup, General Specification for
MIL-W-81044	Wire, Electric, Crosslinked Polyalkene, Crosslinked Alkane-imide Polymer, or Polyarylene Insulated, Copper or Copper Alloy
MIL-W-81381	Wire, Electric, Polyimide-Insulated, Copper or Copper Alloy

MS25471	Wire, Electrical, Silicone Insulated, Copper, 600 Volt, 200°C, Polyester Jacket
MS27110	Wire, Electrical, Silicone Insulated, Copper, 600 Volt, 200°C, FEP Jacket
ASTM B33-74	Tinned Soft or Annealed Copper Wire for Electrical Purposes

3. Definitions

3.1 Interconnecting wire. Insulated, single-conductor wire used to carry electric current between units.

3.2 Interconnecting cable. Two or more insulated conductors contained in a common covering or one or more insulated conductors with a gross metallic shield outer conductor used to carry electrical current between units.

4. Requirements

4.1 Wire selection. Selection of wire for interconnection between units shall be in accordance with table 71-I.

4.2 Multiconductor cable selection. Selection of multiconductor cable for interconnection between units shall be in accordance with table 71-II.

4.3 Application restrictions

4.3.1 MIL-W-76 shall be used for Army application only.

4.3.2 MIL-W-16878 shall not be used for Air Force aerospace equipment.

* 4.3.3 Cable or wire with polyvinyl chloride insulation shall not be used in aerospace applications. Use of these wires or cables in any other Air Force or Army Missile Command application requires prior approval of the procuring activity.

4.3.4 MIL-W-22759 wire with only single polytetrafluoroethylene insulation used in Air Force space and missile applications shall require the approval of the procuring activity.

4.3.5 Use of aluminum wire requires specific approval by the procuring activity.

* 4.36 Silver plated copper wire shall not be used in applications involving Army missile systems.

5. Information for guidance only

5.1 Pulsed or rf signals. All interconnecting cables carrying pulsed or rf signals should be coaxial cables or waveguides and should be terminated, when possible, in the characteristic impedance of the transmitting media.

TABLE 71-I. Wire, electrical, interconnection

Spec No.	Title	Spec Type or Class	CONSTRUCTION 1/ Conductor: Material	Conductor: Coating	Conductor: Type	2/ Insulation: Primary	Insulation: Primary Cover	Insulation: Jacket/ Topcoat	Max Cond Temp °C	Max rms Volts	Remarks
MIL-W-76	Wire and Cable, Hookup, Electrical Insulated	LW	Cu/A or CCW	Sn	S, Str	1	8,10, 13A 3/	8,10, 13A 3/	80	300	See Notes 4 and 5. For Army use only
		MW								1000	
		HW								2500	
		HF				2A				1000	
MIL-W-5086	Wire, Electric, PVC Insulated, Copper or Copper Alloy	M5086/1	Cu/A	Sn	Str	1	13A	8	105	600	
		M5086/2						8, 11			
		M5086/3								3000	Medium weight
		M5086/4						8			
		M5086/5						9A	110	600	See Note 4
		M5086/6	HSA	Ag							
		M5086/7	Cu/A	Sn				8	105		
MIL-W-8777	Wire, Electrical, Silicone Insulated, Copper, 600 V 200°C	MS25471	Cu/A	Ag	Str	6	13A	12	200	600	
		MS27110						4A			
MIL-W-16878	Wire, Electrical, Insulated, High Temperature	M16878/1	Cu/A, HSA, CCW	Ag,Sn	S,Str	1	8,10,11	1,8,10,11	105	600	See Note 4
		M16878/2								1000	
		M16878/3								3000	
		M16878/4		Ag		3A		3A,3B,4A 13B 3/	200	600	
		M16878/5								1000	
		M16878/6								250	
		M16878/7	Cu/A			6	4A,8, 10, 11	4A,8,10, 11		600	
		M16878/8								1000	
		M16878/10	Cu/A, CCW	Sn		2A	8,10,11		75	600	
		M16878/11		Ag		4A		4A	200	1000	
		M16878/12								250	
		M16878/13									
		M16878/14	Cu/A	Ag,Sn	S,Str	2C			125	600	
		M16878/15		Sn						1000	
		M16878/16								600	
		M16878/17	Cu/A, HSA, CCW	Ag,Sn		1		8	105	3000	
		M16878/18								1000	
		M16878/19								3000	
		M16878/20		Ag		3B		3A,3B,4A 13B 3/	200	250	
		M16878/21								600	
		M16878/22								1000	
		M16878/23		Ni		3A			260	250	
		M16878/24				3B					
		M16878/25				3A				600	
		M16878/26				3B					
		M16878/27				3A				1000	
		M16878/28				3B					
		M16878/29	Cu/A	Sn	Str	6			150	600	
		M16878/30								1000	
		M16878/31									
		M16878/32		Ag					200		
		M16878/33	Cu/A CCW	Sn	S,Str	2A			75	600	
		M16878/34	Cu/A	Ag	Str	3B			200	1000	
		M16878/35		Ni					260		

TABLE 71-I. Wire, electrical, interconnection. - Continued

Spec No.	Title	Spec Type or Class	CONSTRUCTION 1/ Conductor Material	Conductor Coating	Insulation Type	Insulation Primary	Insulation Primary Cover	Insulation Jacket/ Topcoat	Max Cond Temp °C	Max rms Volts	Remarks
MIL-W-19150	Wire, Insulated, Hard-Drawn Copper		Cu/H			2A		8			
MIL-W-22759	Wire, Electric, Fluoropolymer-insulated, Copper or Copper Alloy	M22759/1	CuA	Ag	Str	3A,3B, 3D		13B	200	600	Medium weight
		M22759/2		Ni					260		Medium weight
		M22759/3				3B,3D	13B	3B			
		M22759/4		Ag				4A	200		
		M22759/5				3C					
		M22759/6		Ni					260		
		M22759/7		Ag					200		
		M22759/8		Ni					260		
		M22759/9		Ag		3A			200	1000	
		M22759/10		Ni					260		
		M22759/11		Ag					200	600	
		M22759/12		Ni					260		
		M22759/13		Sn		4A		9A	135		Medium weight
		M22759/14									Light weight
		M22759/15	HSA	Ag							Light weight
		M22759/16	Cu/A	Sn							Medium weight
		M22759/17	HSA	Ag		18			150		Medium weight
		M22759/18	Cu/A	Sn							Light weight
		M22759/19	HSA	Ag							Light weight
		M22759/20							200	1000	
		M22759/21		Ni				3A	260		
		M22759/22		Ag					200	600	
		M22759/23		Ni					260		
		M22759/28	Cu/A	Ag					200		
		M22759/29		Ni		3A		7B	260		
		M22759/30	HSA	Ag					200		
		M22759/31		Ni							
		M22759/32	Cu/A	Sn					150		
		M22759/33	HSA	Ag					200		
		M22759/34	Cu/A	Sn					150		
		M22759/35	HSA	Ag		20		20			
		M22759/41	Cu/A	Ni					200		
		M22759/42	HSA								
		M22759/43	Cu/A	Ag							
MIL-W-25038	Wire, Electrical, High Temperature and Fire Resistant	M25038/1	Cu/A	Ni clad	Str	15	3B	13B	288	600	Critical circuits where electrical integrity must be maintained during fire (1093°C flame/ 5 min)
MIL-W-81044	Wire, Electric, Cross-linked Polyalkene, Cross-linked Alkane-imide Polymer, etc Insulated, Copper or Copper Alloy	M81044/6	Cu/A	Sn	Str	2B		9B	150	600	Sheets /12 & /13 light weight - See Note 4 Sheets /9 & /10 medium weight. See application temp limitation stipulated on detail specification sheet
		M81044/7	HSA	Ag							
		M81044/9	Cu/A	Sn							
		M81044/10	HSA	Ag							
		M81044/12	Cu/A	Sn							
		M81044/13	HSA	Ag							

TABLE 71-I. Wire, electrical, interconnection. - Continued

Spec No.	Title	Spec Type or Class	CONSTRUCTION 1/ Conductor Material	Conductor Coating	Insulation Type	Insulation 2/ Primary	Insulation Primary Cover	Insulation Jacket/ Topcoat	Max Cond Temp °C	Max rms Volts	Remarks
MIL-W-81381	Wire, Electric, Polyimide Insulated, Copper or Copper Alloy	M81381/7	Cu/A	Ag	Str	7A		17	200	600	Sheets /7 through /10 light weight Sheets /11 through /14 medium weight Sheets /17 through /20 light weight, single wrap primary Interconnect wiring where weight, space, and high temperature capability are critical Sheets /7 through /10 & /17 through /20 - See Note 4 3B jackets in sheets /11, /12 & /22 are in sizes 8 and larger
		M81381/8		Ni							
		M81381/9	HSA	Ag							
		M81381/10		Ni							
		M81381/11	Cu/A	Ag				15 or 17			
		M81381/12		Ni							
		M81381/13	HSA	Ag							
		M81381/14		Ni							
		M81381/17	Cu/A	Ag				17			
		M81381/18		Ni							
		M81381/19	HSA	Ag							
		M81381/20		Ni							
		M81381/21	Cu/A	Sn					105		
		M81381/22						15 or 17			

NOTES:

1/

Conductor Code		Description
Material	Cu/A	Copper, annealed
	Cu/H	Copper, hard-drawn
	CCW	Copper covered steel
	HSA	High strength copper alloy
	Al	Aluminum
Coating	Sn	Tin
	Ag	Silver
	Ni	Nickel
Type	S	Solid
	Str	Stranded

2/

Insulation Code	Description
1	Polyvinyl chloride/extruded
2A	Polyethylene/extruded
2B	Polyalkene/cross-linked extruded
2C	Polyethylene/cross-linked/modified/extruded
3A	Polytetrafluoroethylene/extruded (TFE Teflon)
3B	Polytetrafluoroethylene/tape
3C	Polytetrafluoroethylene/mineral filled/extruded
3D	Polytetrafluoroethylene impregnated glass type
4A	Fluorinated-ethylene propylene/extruded (FEP Teflon)
4B	Fluorinated-ethylene propylene/dispersion
5	Monochlorotrifluoroethylene/extruded (Kel-F)
6	Silicone rubber/extruded
7A	FEP/polyimide film (Kapton)
7B	Polyimide lacquer (Pure ML)
8	Polyamide/extruded (Nylon)
9A	Polyvinylidene fluoride/extruded (Kynar)
9B	Polyvinylidene fluoride/extruded/cross-linked
10	Braid/synthethic yarn/lacquer impregnated
11	Braid/nylon/impregnated
12	Braid/polyester/impregnated
13A	Braid/glass fiber/impregnated
13B	Braid/TFE coated glass fiber/TFE finish
14	Braid/asbestos/TFE impregnated
15	Braid, weave or wrap/inorganic fiber
16	Alkane-imide polymer/extruded/cross-linked
17	Modifed aromatic polyimide
18	Ethylene-tetrafluoroethylene/extruded (Tefzel)
19	Polyarylene/extruded
20	Cross-linked, extruded, modified ethylene-tetrafluoroethylene

3/ When specified on purchase order

4/ Wire intended for use in electronic equipment hook-up applications. It may also be used as an interconnecting wire when an additional jacket or other mechanical protection is provided.

5/ Various combinations of primary, primary cover, and jacket insulations and unshielded, shielded, etc, constructions are available to meet application requirements. See detail wire specification.

TABLE 71-II. Cable, multiconductor, interconnection.

Spec No.	Title	Basic Wire Specs	Conductor			Shield Braid 3/			Jacket 3/		Remarks
			No. of Cond	Volts RMS	Temp 2/	Strand Material	Strand Coating	% Coverage	Material 1/	Type	
MIL-C-442	Cable, (Wire), Two Conductor, Parallel	QQ-W-343 & Insulation	2	300	Flexibility at -40°C or -55°C				Vinyl-polymer or synthetic (styrene butadiene) rubber or natural rubber		Lead wire for firing explosive charges
MIL-C-3432	Cable (Power and Special Purpose) and Wire, Electrical (300 & 600V)	QQ-W-343 & Insulation	Unlimited and mixed sizes 4/ 5/	300 & 600	-40°C to +65°C or -55°C to +75°C	None or Copper	Tin	85	Styrene butadiene or chloroprene rubber	Extruded & vulcanized	
MIL-C-7078	Cable, Electric, Aerospace Vehicle	M5086/1 M5086/2 M5086/3	2-7 1-7 1-7	600	105°C	Copper Copper	Tin Tin		None Polyamide (Nylon)	Extruded or ImpregBraid	(a) Fluorinated ethylene propylene (b) Polytetrafluoroethylene
		M22759/12 M22759/23	1-7 1-7		260°C 260°C	Copper Copper	Nickel Nickel	85 85	(a) (b)	Extruded Extruded or tape	
		M81044/9	1-7		110°C	Copper	Tin	85	Polyvinylidene fluoride	Extruded	
		M81381/8 /10 and /14	2-7 1-7		200°C 200°C	Copper	Nickel	85	FEP/polyimide	Film Tape	
		M81381/11 M81381/12 M81381/13	2-7 1-7 1-7		200°C 150°C 200°C	Copper Copper	Tin Nickel	85 85	FEP/polyimide	Film Tape	
MIL-C-13777	Cable, Special Purpose Electrical	MIL-C-17 QQ-W-343 QQ-W-423 & Insulation	2-78 6/	600	-53°C to +71°C	Copper	Tin	80	Sheath Polychloroprene Primary Insulation Polyethylene	Extruded & vulcanized Extruded	See Note 7
MIL-C-19547	Cable, Electrical, Special purpose, Shore Use	ASTM B33-74 & Insulation	Multiple twisted pairs, 6-100 pairs	600	75°C	Corrugated Aluminun		100	Polyethylene	Extruded	For use as telephone & telegraph signal cables in shore communications
MIL-C-21609	Cable, Electrical, Shielded 600V (for Non-flex Service)	MIL-C-17 MIL-W-5086 MIL-C-24640	2-61	600	105°C	Electrolytic tough pitch copper tape	Annealed tape tinned	Not specified	Black polyamide over black PVC		

TABLE 71-II. Cable, multiconductor, interconnection - Continued

Spec No.	Title	Basic Wire Specs	Conductor			Shield Braid 3/			Jacket 3/		Remarks
			No. of Cond	Volts RMS	Temp 2/	Strand Material	Strand Coating	% Coverage	Material 1/	Type	
MIL-C-23437	Cable, Electrical, Shielded Pairs	MIL-W-16878/1	Shielded & jacketed twisted pairs 1 pair-104 pairs	600	105°	Copper	Tin	90	PVC	Extruded	For use within shore communications stations, not to be used on board ship
						Note: Shield applied over each pair					
MIL-C-27072	Cable Special Purpose, Electrical, Multi-conductor	MIL-C-17	2-36	Various	Not Spec	Copper	Tin, Silver	85	Sheath of PVC, polyethylene, polychloroprene, polyamide, TFE-Teflon, or FEP-Teflon		Flexible multi-conductor cable for use in protected areas: tunnels, wire ways, instrument racks, and conduit. Polyethylene jacketed cable suitable for underwater or direct burial applications only. M16878/6 and /13 not for aerospace applications.
		MIL-W-5845		Various	Not spec						
		MIL-W-5846		Various	Not spec						
		MIL-W-5908		Various	Not spec						
		M16878/1		600	105°C						
		M16878/2		1000	105°C						
		M16878/3		3000	105°C						
		M16878/4		600	200°C						
		M16878/5		1000	200°C						
		M16878/6		250	200°C						
		M16878/10		600	75°C						
		M16878/13		250	200°C						
						Note: MIL-C-27072 applicable detail specification sheets control materials for each specific cable configuration.					
MIL-C-27500	Cable, Electrical, Shielded and Unshielded, Aerospace	MIL-W-8777	1-7	600	200°C	Various	Various	85	Various	Braided	For general aerospace flight vehicle applications
		MIL-W-22759	1-7	Various	Various	Various	Various	85	Various	Extruded or Braided	
		MIL-W-25038	1-7	600	260°C	Various	Various	85	TFE coated glass fiber	Braided	
		MIL-W-81044	1-7	600	150°C	Various	Various	85	Various	Extruded	
		MIL-W-81381	1-7	600	Various	Various	Various	85	Various	Tape	
MIL-C-55021	Cable, Twisted Pairs & Triples, Internal Hookup, General Specification for	MIL-W-16878	2-3	600 to 1000	-40°C to +80°C or -65°C to +200°C	None or Copper	Tin, Silver or Nickel	90	None PVC, Nylon TFE-Teflon	Extruded Extruded or Tape	

TABLE 71-II. Cable, multiconductor, interconnection. - Continued

NOTES:

1/ Polyester - Polyethylene Terephthalate
TFE-Teflon - Polytetrafluoroethylene
PVC - Polyvinyl chloride (Not to be used in airborne applications)
KEL-F - Polymonochlorotrifluoroethylene
FEP-Teflon - Fluorinated ethylene propylene
PVF - Polyvinylidene fluoride

2/ See applicable detail specification sheet for temperature limitation.

3/ See applicable detail specification sheet for materials control of specific cable configurations

4/ Although the specification does not limit the number of conductors in a cable, the size, weight, and flexibility are determining factors.

5/ Available in three classifications:

Class L - Light Duty - to withstand severe flexing and frequent manipulation

Class M - Medium Duty - to withstand severe flexing and mechanical abuse

Class H - Heavy Duty - to withstand severe flexing and mechanical abuse and ability to withstand severe service impacts such as to be run over by tanks or trucks

6/ See applicable detail specification sheet for mechanical test requirements for cold bend, cold bend torque, impact bend, and twist.

7/ For use under abusive mechanical conditions and where resistance to weather, oil and ozone are requirements.

INDEX OF APPLICABLE DOCUMENTS

Document	Requirement
MIL-I-23594	11
MIL-T-23648	33
MIL-C-23806	65
MIL-G-23827	43
MIL-M-24041	47
MIL-I-24092	11
MIL-G-24139	43
MIL-A-24179	23
MIL-I-24204	11
MIL-G-24211	53
MIL-R-24243	12
MIL-S-24251	60
MIL-M-24325	26
MIL-I-24391	11
MIL-G-24508	43
MIL-C-24640	66, 71
MIL-C-24643	66, 71
MIL-N-25027	12
MIL-W-25038	66, 71
MIL-K-25049	28
MIL-A-25463	23
MIL-H-25475	49
MIL-P-25518	26
MIL-C-27072	66, 71
MIL-W-27265	44
MIL-R-27384	12
MIL-C-27500	66, 71
MIL-D-28728	28
MIL-M-28787	73
MIL-R-28803	68
MIL-C-28809	17
MIL-A-28870	17
MIL-M-38510	64, 75
MIL-M-38527	60
MIL-C-39006/22	2
MIL-C-39006/25	2
MIL-T-43435	69
MIL-S-46049	41
MIL-A-46050	23
MIL-I-46058	17
MIL-P-46112	26
MIL-W-46132	13
MIL-A-46146	23
MIL-S-46163	12
MIL-P-46843	17
MIL-I-46852	11
MIL-H-46855	62
MIL-A-48611	23
MIL-B-49030	27
MIL-B-49430	27
MIL-B-49436	27
MIL-B-49458	27
MIL-B-49461	27
MIL-R-50781	56
MIL-P-50884	17
MIL-A-52194	23
MIL-C-55021	66, 71
MIL-S-55041	53
MIL-P-55110	17
MIL-C-55116	10
MIL-B-55118	27
MIL-B-55130	27
MIL-T-55156	19
MIL-T-55164	19
MIL-C-55181	10
MIL-B-55252	27
MIL-O-55310	38
MIL-A-55339	10
MIL-T-55631	14
MIL-C-81021	41
MIL-W-81044	20, 66, 71

Document	Requirement
MIL-STD-783	67
MIL-STD-785	35, 64
MIL-STD-810	4
MIL-STD-883	64, 75
MIL-STD-889	15, 16
MIL-STD-965	22
MIL-STD-975	64
MIL-STD-981	14
MIL-STD-1130	69
MIL-STD-1132	58
MIL-STD-1189	67
MIL-STD-1261	13
MIL-STD-1275	25
MIL-STD-1277	19
MIL-STD-1279	51
MIL-STD-1285	67
MIL-STD-1286	14
MIL-STD-1310	1, 74
MIL-STD-1327	53
MIL-STD-1328	53
MIL-STD-1329	53
MIL-STD-1334	6
MIL-STD-1346	57
MIL-STD-1352	53
MIL-STD-1353	10
MIL-STD-1358	53
MIL-STD-1360	39
MIL-STD-1378	73
MIL-STD-1389	73
MIL-STD-1395	70
DOD-STD-1399	25
MIL-STD-1451	56
MIL-STD-1472	1, 36, 50, 62
MIL-STD-1498	37
MIL-STD-1516	15
MIL-STD-1539	8, 25
MIL-STD-1542	74
MIL-STD-1546	22
MIL-STD-1547	18, 30, 64
MIL-STD-1562	64
DOD-STD-1578	27
MIL-STD-1595	13
MIL-STD-1629	35
MIL-STD-1636	53
MIL-STD-1637	53
MIL-STD-1638	53
MIL-STD-1639	53
MIL-STD-1640	53
MIL-STD-1646	10
MIL-STD-1686	64, 75
MIL-STD-1857	74
DOD-STD-2000-1	5
DOD-STD-2000-2	5
DOD-STD-2000-3	5
DOD-STD-2000-4	5
MIL-STD-2113	53
MIL-STD-2118	17
MIL-STD-2119	17
MIL-STD-2120	10
MIL-STD-2162	53
MIL-STD-2165	32
MIL-STD-2175	21
MS25471	71
MS27110	71
MS27212	19
MS33522	12
MS33540	12
MS33557	12
MS33558	42